GREENING IN THE RED ZONE: VALUING COMMUNITY-BASED ECOLOGICAL RESTORATION IN HUMAN VULNERABILITY AND SECURITY CONTEXTS

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GREENING IN THE RED ZONE: VALUING COMMUNITY-BASED ECOLOGICAL RESTORATION IN HUMAN VULNERABILITY AND SECURITY CONTEXTS

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This dissertation explores the role of community-based ecological restoration, or "greening," after destructive large–scale geophysical, technical, or military events. It raises the question "why do people turn to greening in the face of conflict and disaster?" This work expands upon explanations from a growing body of research on the impacts of more passive contact with nature, as well as a smaller literature on the outcomes of the act or active practice of nature stewardship. As such, it draws upon a growing network of "resilience scholars" -- social and ecological scientists who argue that change is to be expected and planned for, and that identifying *sources* of resilience in the face of change is crucial to the long-term well-being of humans, their communities, and the local environment. This dissertation addresses several gaps in the resilience literature, including (1) the lack of studies focused on cultural systems, (2) the relatively few studies that explicitly re-embed humans in ecosystems, and (3) the need for more studies that integrate the theory and science of individual human resilience with broader ecological systems theory and research exemplified by social-ecological systems (SES) resilience scholarship. Papers in this dissertation provide results on symbol and ritual understandings of trees and tree planting after disaster, and how these ecological symbols and rituals contribute to re-creation and restoration of sense of place, perhaps a first principle in restoration of social and natural capital and the attendant abilities of people to participate in restarting previously existing, or

in catalyzing new virtuous cycles within SES. Results from the specific case of New Orleans after Hurricane Katrina also show how tree symbols and rituals are remembered, reconstituted, and reproduced, and come to represent a cluster of social mechanisms that can be viewed as tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience. The dissertation as a whole argues that the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components; and feedbacks and cycles catalyzed by relationships among trees, forests and humans, all contribute to system memory, processes involved in regeneration, renewal, and resilience.

BIOGRAPHICAL SKETCH

Keith G. Tidball is a Senior Extension Associate in the Department of Natural Resources at Cornell University where he serves as Associate Director of the Civic Ecology Lab and Program Leader for the Lab's Nature & Human Security theme. He is also the New York State Coordinator for the Cornell Cooperative Extension New York Extension Disaster Education Network. His research is focused on the interactions between humans and nature in the context of disasters and war. He is particularly interested in how these interactions relate to social-ecological system resilience, or in other words, how humans and their interactions with nature are related to a system's ability to bounce back after being disturbed. Prior to his work at Cornell, Tidball served in the US armed forces as an enlisted soldier and later as an officer in the US Army (reserve). He later spent four years working as an International Affairs Specialist for the US Department of Agriculture Foreign Agriculture Service, where he specialized in sustainable agriculture and resource management in disaster and conflict settings.

Keith lives with his family in the Canoga Creek sub-watershed, overlooking Canoga Marsh at the north end of Cayuga Lake with his wife Moira and two children Victoria and Charlotte. The Tidball family began the Canoga Creek Farm and Conservancy in 2002 and has focused their family life on sustainability through the celebration and preservation of the land ethic, and the conservation of agrobiodiversity and natural resources.

I dedicate this work:

…to the memory of my mother, who taught me the value of defying the limitations of the “impossible” and of fighting the tyranny of apathy and indifference.

…to the unquenchable lust for life and the living, and the eternal optimism of the human spirit.

…to the inspiration that is New Orleans.

…and to the memory of and in gratitude for the life of Mark Bain (1955–2012), scientist, PhD committee member, and friend.

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Exchanges Division, allowing me the opportunity to observe and experience firsthand throughout the world the phenomena that is the subject of this dissertation; Karin, while working with me at USDA, introduced me to Cornell University, her alma mater. I wish to acknowledge friends and colleagues from institutions that were especially important and formative in my training: from Albion College, Jack Padgett of the Philosophy Department and Kim Tunnicliff of the Gerald R. Ford Institute for Public Service, as well as Coaches Pete Schmidt and Len Vanden Bos of the Albion Football program; from the University of Kentucky, Christopher Toumey and Monica Udvardy of the Department of Anthropology, Vince Davis of the Patterson School of Diplomacy and International Commerce, and Rhonda Strouse of the Division of Student Affairs; from The George Washington University, David Gow and Patricia Delaney of the Elliott School for International Affairs; and from the United States Army Kentucky National Guard, LTC Allen Boone. To Robert E. Ginna Jr., I offer my deep gratitude for well-timed and important encouragement. Thanks to the librarians and staff of Mann Library for the excellent reference assistance, to Erin Kelly for tireless and cheerful administrative support throughout my journey through Cornell's Employee Degree Program, and to my many helpful colleagues and friends within the Department of Natural Resources.

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PREFACE

At the international conference *Resilience 2008*, which gathered more than 600 leading ecological scientists, business leaders and politicians in Stockholm, Sweden, I was struck by the *Changing Matters* art exhibit that explored social-ecological resilience themes. One of the artists, Jon Brunberg, shared a piece called *19 Years*, a one-minute Flash animation that depicts the more than 91 million people around the world who took part in mass demonstrations between 1989 and 2007, crying out for change.[1] Locational dots appear on a screen showing a world map, gradually at first, but increasing in intensity, accompanied by the jolting sounds of fire-crackers popping, each corresponding with the appearance of a new dot, a new mass demonstration. The dots and sounds crescendo to an alarming level as time passes, communicating the urgency and power of humanity's will and alluding to their capacity to change things, to shake their realities into new ones. Experiencing this art is a sublime experience, paradoxical in its inspiring yet disturbing spectacle. One is moved, somewhat overwhelmed, alarmed and yet optimistic.

Similarly, in post-disaster and post-conflict situations, I have seen equally overwhelming, alarming, and yet optimistic human responses, demonstrating the extraordinary resilience of our species. Some of the most intriguing and inspirational responses to disaster and conflict are found in the mysterious realms of altruism. One needs only to recall the week of September 11th, 2001, to conjure images of selfless heroes and an understanding of this type of response. Another form of response is

somewhat more muted, but in the end, perhaps equally, or even more profound. I am referring to the response by both individual and groups of humans to return to "nature" when calamity strikes, to actively seek intimacy with other living things, to retreat (or advance!) to life-affirming interactions in verdant, alive contexts. I am highlighting how brave people combine their own fate with that of the animal, tree, flower, forest or garden that lives or dies. This type of response, the many motives and explanations for how it comes about, and the implications of its presence and efficacy is an area of inquiry that I call "greening in the red zone" and is the name and subject of this dissertation.

At the time of this writing, the conclusion of the first decade of the 21st century, the world is still reeling from what seems to many to be increasingly frequent perturbances; recent multiple earthquakes and disasters (Japan, Haiti, Chile, China, and others) have punctuated an already chaotic ten-year period that has seen buildings felled by terrorists from New York City to Nairobi, wars in the Middle East, catastrophic flooding in New Orleans, mudslides, typhoons, and the list goes on. But as troubling as these events are, they are not in themselves particularly new phenomena. Even in my own lifetime, I have noticed the predictable likelihood that disasters will happen.

I was raised the child of a minister in the prairie country of Minnesota. We were not strangers to natural disasters; every summer communities near us, and sometimes our own community, experienced the devastating power of tornadoes. I grew up with '70's

[1] See Changing Matters- The Resilience Art Exhibition, 2008. http://resilience2008.org/resilience/?page=php/art and

era TV images of families weeping while standing where their trailer used to be, or where their barn used to be, or even standing where they last saw members of their family. These were terrifying images, but they were also fascinating. I was at an early age captivated by the human survival instinct in the wake of calamity, and motivated to gain an experiential understanding of these human traits.

Being a minister's child, I was exposed to different cultures around the world through missionaries. In the summer of 1988, between my junior and senior year of high school, I experienced my first international disaster. I travelled to Haiti to work with Mission Aviation Fellowship (MAF), a faith-based, nonprofit organization[2] founded by military pilots to use aircraft to help missionaries respond to disasters. We were assisting a community near Cap-Haïtien which had experienced damage to hillside buildings, including a school, during Hurricane Emily in 1987. It was here that I began to understand the links between people, the rest of nature, and the outcomes of surprise events like natural disasters or other catastrophes.

According to Jane Deren[3] of Education for Justice, during the 1980's, Haiti still had 25% of its forests, which allowed the tropical island nation to endure rain events like 1987's Category 3 Hurricane Emily, with minimal loss of life. But, she says, as of 2004, only 1.4% of Haiti's forests remained. The effects of this slow erosion of a source of Haitian social-ecological system resilience are now being felt. Storms Jeanne and Gordon were not even officially hurricanes when they descended upon

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http://jonbrunberg.com/19y/

[2] See www.maf.org. MAF currently operates 136 light aircraft to support their outreach and humanitarian relief and development activities in 38 nations, providing aviation support in a variety of settings.

Haiti, but the almost complete lack of tree cover has been pointed to as a major contributing factor to the devastating floods that killed thousands. And, according to some, it doesn't even take a tropical storm to seriously disrupt the Haitian system--in May of 2004, three days of heavy rains from a tropical disturbance dumped more than 18 inches of rain in the mountains, triggering floods that killed over 2600 people. Tragically, the tens of thousands of Haitians who died as a result of the 2010 earthquake are perhaps further testimony to the loss of resilience within the Haitian social-ecological system[4].

My own experience in disaster relief in Haiti over 20 years ago was extraordinary in many ways, but one experience stands out in particular. There was a small school perched precariously on a slope. The school had been closed since the storm of a year earlier, as it was deemed unsafe. Portions of the exterior showed signs of slumping down the hill. Every day, women and older men were planting small trees on the uphill side of the building. I asked someone one day what they were doing, and the person replied, in a rather condescending way, that they were wasting their time trying to save the school. About a week later, I heard a man yelling and whistling shrilly. I looked in the direction of the noise and saw the tree planters scurrying away from the school. Moments later, the building totally collapsed and slid a little ways down the hill. The entire community seemed to assemble at the site within minutes, and there could be heard great cries and wailing, yet thankfully, no one was injured. After about an hour of this, the women who were planting trees, and two or three of the old men

[3] See Deren, J. 2008. Hurricanes and Haiti: A Tragic History. Education for Justice. http://www.loyola.edu/ccsj/HaitiRelief/HaitiHurricanes08_0.pdf

[4] For an exhaustive body of work on Haiti and forestry, see anthropologist Gerald F. Murray's research portfolio at: http://www.clas.ufl.edu/users/murray/Research/Haiti/Haiti.index.html

trudged up the slope and resumed their planting. Slowly, others climbed to assist, until there were maybe 30 people on the side of the hill above the rubble. I was greatly moved.

Later, I mustered the courage to ask our host to help me pose some questions to the tree planters. I asked them why they continued to plant trees when the school was destroyed. The interpreter asked my question in Creole, and there were many answers, and much hand waving. I thought I had offended the people. Then, the interpreter turned to me with tears in his eyes. He said, “We didn’t plant the trees to save the school. We planted the trees to save the children in the school. We are still planting the trees because we are still worried about our children. We are planting the trees because there is nothing else we can do. See? We are not crying here, we are planting trees.”

It is my hope that this dissertation will not only contribute to scientific knowledge, but will also be useful to policy makers and planners in post-conflict and post-disaster contexts, and affirming and inspiring to community greeners everywhere. I am optimistic that humanity can remember its collective connections to the rest of the biosphere, especially in times of crisis, and it is my desire that this dissertation will be of use in some way to us all on ever-changing planet earth.

CHAPTER 1

INTRODUCTION- SYNOPSIS AND LIST OF PAPERS

Synopsis

Despite the fact that we live in the anthropocene – an age where humans dominate so-called natural systems – it is not a foregone conclusion that *all* of our current practices *must* degrade the capacity of natural systems to provide us with benefits and ecosystems services. The ways in which we as humans reorganize, learn, recover and demonstrate resilience through remembering and operationalizing the value of our relationships with elements of our shared ecologies in the direst of circumstances such as disaster and war hold clues to how we might increase human resilience to new surprises, while contributing sources of social-ecological resilience to ecosystems. This dissertation studies the role of community-based ecological restoration, often called "greening," in the aftermath of destructive large–scale geophysical, technical, or military events. It seeks to understand why people turn to greening in the face of conflict and disaster. What motivates them, and what are the implications for themselves, their community, and their local environment? In so doing, this work has turned to explanations from a growing body of research on the impacts of more passive contact with nature, as well as a smaller literature on the outcomes of the act or active practice of nature stewardship. This work also draws on a growing network of "resilience scholars"–social and ecological scientists who subscribe to the notion that change is to be expected and planned for, and that identifying sources of resilience in the face of change—including the ability to adapt and to transform—is crucial to

the long-term well-being of humans, their communities, and the local environment (Gunderson, 2010).

On a more theoretical level, this dissertation addresses several gaps in the resilience literature, including the lack of studies focused on cultural systems , as well as the striking absence of "work that embeds human development in ecosystems that include interactions among species and nonhuman systems" and that integrates the theory and science of individual human resilience with broader ecological systems theory and research exemplified by the SES resilience scholarship (Masten and Obradovic 2008). This dissertation addresses these gaps in several ways. It addresses a role and source of environmental stewardship, social-ecological memory, and resilience in disaster contexts (***Paper I***). It explores the possibilities of multiple explanations for why humans would engage in greening activities from both an evolutionary biological perspective (***Paper II***) and from ecocultural and symbolic perspectives (***Paper III***), and attempts to account for these sources in feedbacks and virtuous cycles that confer additional resilience to disturbed social-ecological systems (***Paper IV and V***). True to ethnographic methods (among other methods employed in the mixed methods model guiding the study), this dissertation situates inquiry into the above areas in a specific case, that of Post-Katrina New Orleans (***Paper I, III, V***). But above all, it not only explores the role of greening in red zones and associated social and ecological feedbacks, it identifies systems processes and mechanisms that begin to explain greening in the red zone and suggests greater utilization, application, and generalization of greening in red zones by governments and institutions called upon to respond to disaster or conflict contexts (***Paper I, II, III, IV, V***). In so doing, it invites

the reader to ponder the implication of frequent human impulses to reconnect with living systems when confronted with major upheaval, and to consider the importance of "remembering our way back" to biological realities and ecological identities for human society as we endeavor to envision vibrant, verdant, resilient futures for forthcoming generations of human members of the biosphere in the 21st century.

The primary methods applied in this study are qualitative; however, the study employs a mixed methods model orientation reflecting a critical realist epistemological and methodological approach (see Appendix 1, this volume). Retroductive hypothetical model building is used to generate explanatory hypothesis. Semi-structured in depth interviews analyzed using content analysis and photo elicitation/essay are employed to derive meanings and motivations for greening in red zones, and to refine initial models. Several papers also build on and review secondary data, aiming to contribute to conceptual clarity and improvements of theory in the field of social-ecological systems.

Papers presented in this dissertation provide results on symbol and ritual understandings of trees and tree planting in the wake of a major perturbation, and how these ecological symbols and rituals contribute to recreation and restoration of sense of place, which may be a first principle in restoration of social and natural capital and the attendant abilities of people to participate in restarting previously existing or in catalyzing new virtuous cycles within social-ecological systems. Results from the specific case of New Orleans after Hurricane Katrina also show how tree symbols and

rituals are remembered, reconstituted, and reproduced, and come to represent a cluster of social mechanisms that can be viewed as "tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience." The dissertation as a whole argues that the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components, and feedbacks and cycles catalyzed by relationships among trees, forests and humans, all contribute to system memory, processes involved in "regeneration and renewal that connect that system's present to its past" (Gunderson, 2000). When a system remembers system properties, such as human-nature interactions that produce, restore and enhance mutually beneficial outcomes for biophysical and psychosocial elements of the system, and those system memories are subsequently reified through social-ecological symbols and rituals, a unique possibility for social-ecological system resilience is introduced. Human-nature interactions, particularly those of a class of human-nature interactions called civic ecology practices such as community reforestation, enhance the ability of people in red zones to organize, learn, and act to increase their capacity to withstand, and even grow from, rapid change and uncertainty through nurturing cultural and ecological diversity, through creating opportunities for civic participation or self-organization, and through fostering new and novel ways of learning from different types of knowledge.

Keywords

Civic Ecology, Greening, Post-conflict, Post-disaster, Environment and Security, Resilience, Community-Based Ecological Restoration, Environment Shaping, Symbols and Ritual, Virtuous Cycles, Vulnerability

List of Papers

This dissertation is comprised of the following papers, referred to by their upper case Roman numerals.

I) Tidball, KG, ME Krasny, E Svendsen, L Campbell, & K Helphand. 2010. Stewardship, Learning, and Memory in Disaster Resilience. "Resilience in Social-Ecological Systems: the Role of Learning and Education," Special Issue of Environmental Education Research, 16(5): 341-357.

II) Tidball, KG (2012). Urgent Biophilia: Human-Nature Interactions and Biological Attractions in Disaster Resilience. Ecology and Society, 17(2): 5.

III) Tidball, KG. (2012). Trees and Rebirth: Social-Ecological Symbols, Rituals and Resilience in Post-Katrina New Orleans. In: Tidball and Krasny, Eds., Greening in the Red Zone: Disaster, Resilience, and Community Greening. New York, Springer.

IV) Tidball, KG and RC Stedman. (2012). Positive Dependency and Virtuous Cycles: From Resource Dependence to Resilience in Urban Social-Ecological Systems. Submitted by invitation to Ecological Economics Special Issue "Sustainable Urbanisation: A Resilient Future."

V) Tidball, KG, M Bain, T Elmqvist, and ME Krasny. (2012). Virtuous Cycles that Confer Resilience in Disrupted Social-Ecological Systems. Submitted to Sustainability Science.

In Paper I, Tidball is the primary author but Krasny is credited for contribution of expertise on environmental education and co-authorship. Svendsen, Campbell, and Helphand provided case studies. In Paper II, Tidball is the sole author and developed the theoretical framework. In Paper III, Tidball is the sole author and collected and analyzed the data. In Paper IV, while Tidball is the lead author, the concept and method was developed jointly with Stedman, who also contributed to writing the paper. In Paper V, Tidball's contribution consisted of leadership for authorship and theory development, with conceptual assistance from Bain and Elmqvist, and authorship assistance from Marianne Krasny.

In addition, this dissertation will refer to appendices (beginning on page 262, this volume) and a number of papers by the author, listed below in lower case Roman numerals, which are not part of the dissertation.

i. Tidball, KG and M E Krasny. 2007. "From Risk to Resilience: What Role for Community Greening and Civic Ecology in Cities?" in Wals, Arjen (editor), Social Learning: Towards a more Sustainable World, Wageningen Academic Publishers, Wageningen, The Netherlands.

ii. Weinstein, ED and KG Tidball. 2007. Environment Shaping: an Alternative Approach to Development and Aid. Journal of Intervention and Statebuilding, Vol. 1, Issue 1.

iii. Tidball, KG and Elon D. Weinstein. 2011. Applying the Environment Shaping Methodology: Conceptual and Practical Challenges. Journal of Intervention and Statebuilding, 5(4).

iv. Aktipis, CA, KG Tidball and RC Stedman. 2012. What makes greening a powerful force towards improving neighborhoods and recovering after disaster? Submitted to: Human Ecology.

v. Tidball, KG and ME Krasny. 2012. “Civic Ecology, resilience, and citizen science in disaster zones” in Janis Dickinson and Rick Bonny (editors) Citizen Science: Public Collaboration in Environmental Research. Ithaca, NY, Cornell University Press.

vi. Krasny, ME, KH Pace, KG Tidball, and K Helphand. (In press). Nature Engagement to Foster Resilience in Military Communities. In: KG Tidball and ME Krasny, eds. Greening in the Red Zone: Disaster, Resilience, and Community Greening. New York, Springer.

vii. Tidball, KG and ME Krasny (In press). From Risk to Resilience: Expanding the Role of Community Greening and Civic Ecology in Urban Stability, Security, Transition and Reconstruction Contexts. In: KG Tidball and ME Krasny, eds. Greening in the Red Zone: Disaster, Resilience, and Community Greening. New York, Springer.

viii. Tidball, KG and ME Krasny (In press). Introduction. In: KG Tidball and ME Krasny, eds. Greening in the Red Zone: Disaster, Resilience, and Community Greening. New York, Springer.

ix. Tidball, KG, ED Weinstein and ME Krasny (In press). Synthesis and Conclusion: Applying Greening in Red Zones. In: KG Tidball and ME Krasny, eds. Greening in the Red Zone: Disaster, Resilience, and Community Greening. New York, Springer.

x. McPherson, P. T. and KG Tidball (In press). Disturbances in Urban Social-Ecological Systems: Niche Opportunities for Environmental Education. In ME Krasny and J Dillon, eds. Trans-disciplinary Perspectives in Environmental Education. New York, Peter Lang Publishing.

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Masten, A. S. and J. Obradovic. (2008). Disaster preparation and recovery: lessons from research on resilience in human development. Ecology and Society 13(1):9.

CHAPTER 2

PAPER I - STEWARDSHIP, LEARNING, AND MEMORY IN DISASTER RESILIENCE

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Abstract

In this contribution, we propose and explore the following hypothesis: civic ecology practices, including urban community forestry, community gardening, and other self-organized forms of stewardship of green spaces in cities, are manifestations of how memories of the role of greening in healing can be instrumentalized through social learning to foster social–ecological system (SES) resilience following crisis and disaster. Further, we propose that civic ecology communities of practice within and across cities help to leverage these memories into effective practices, and that these communities of practice serve as urban iterations of the collaborative and adaptive management practices that play a role in SES resilience in more rural settings. We present two urban examples to build support for this hypothesis: the Living Memorials Project in post - 9/11 New York City, and community forestry in New Orleans following Hurricane Katrina. These cases demonstrate what we refer to as a memorialization mechanism that leads to feedbacks critical to SES resilience. The process begins immediately after a crisis, when a spontaneous and collective memorialization of lost ones through gardening and tree planting ensues, following which a community of practice emerges to act upon and apply these memories to social learning about greening practices. This in turn may lead to new kinds of learning, including about collective efficacy and ecosystem services production, through a kind of feedback between remembering, learning, and enhancing individual, social, and environmental well-being. This process, in the case of greening in cities, may confer SES resilience, through contributing to both psychological–social resistance and resilience and ecosystem benefits.

Keywords: resilience; communities of practice; civic ecology; urban; stewardship; memory; disaster; social learning

Introduction

In his 2006 book *Defiant Gardens: Making Gardens in Wartime*, author Kenneth Helphand examines gardening as a response to some of the most hopeless wartime situations in history – gardening by soldiers inside trenches during World War I, gardening in the Warsaw ghetto among Jews knowing they would not survive the holocaust to see their harvest, and gardening by prisoners of war and Japanese-Americans interned in camps. Since publication of the book, hundreds of soldiers have come forth to share with Helphand their memories of how gardening helped them to be "resistant and resilient" (Nucifora et al. 2007) in the midst of war. For example, a former helicopter pilot wrote about how the bananas, watermelons, and periwinkles he planted in Vietnam had:

> *a calming effect on me … after a long day of flying missions in the I Corps area to see a little bit of green growing by my doorway … As small as it was, it was my oasis. I could almost block out the medevac choppers going out and the sound of the artillery in the distance. I have never forgotten much from that war and never my oasis … Thank you for reminding me that even one small little garden can create a sense of peace and hope in the midst of a war and a warrior's heart* (Helphand 2009).

Civilians also recounted their stories. For example, in Colombia, urban squatters and refugees fleeing from violence spoke about the importance of gardening, and posed the rhetorical question of why kidnappers in Colombia did not even allow their victims a garden, a charge that exemplified their cruelty. And newspapers in Iraq reported on the work of Baghdad parks supervisor Jaafar Hamid al Ali, whose

"principle is, for every drop of Iraqi blood, we must plant something green" (Helphand 2009).

Perhaps it is not surprising that interacting with nature through gardening offers a means of resistance and resilience for individual soldiers and civilians during war, given the large literature on the therapeutic benefits of plant–people interactions (Markee and Janick 1979; People Plant Council 1993; Relf 2005; Relf and Dorn 1995), and more specifically on the therapeutic qualities of gardening to ease trauma and to aid the process of recovery in individuals stunned by a crisis (Hewson 2001; Miavitz 1998). Beyond the therapeutic value of plants and gardening per se, Kaplan and Kaplan (1989) and Ulrich (1983) have researched the role of green places, or restorative environments (Kaplan and Kaplan 1978), in easing trauma or discomfort (Campbell and Wiesen 2009; Kaplan and Peterson 1993). Furthermore, studies have pointed to the symbolic value individuals place on trees, treescapes, and other aspects of nature immediately after a catastrophe (Anderson 2004; Jones and Cloke 2002; Miller 1997; Perlman 1994). For example, in a study of Charleston, South Carolina after Hurricane Hugo, Hull (1992, p. 100) concluded: "the role of urban forests as symbols of cherished meanings and memories needs to be emphasized as a major benefit deriving from urban forestry … Trees symbolize spiritual values, personal memories, reminders of the past, preservation and endurance." Thus, plants as well as interacting with plants (e.g., through gardening, tree planting) appear to aid in resistance and resilience not only through therapeutic effects linked to psychology, but also through eliciting memories.

Thus far, we have used the terms resistance and resilience as in the fields of human development, disaster medicine, public health, and preparedness (cf. Nucifora et al.

2007; Patton and Johnston 2001; Powley 2009). So, resistance refers to the ability of an individual, group, organization, or entire population to withstand manifestations of clinical distress, impairment, or dysfunction, and resilience to the ability of an individual, group, organization, or entire population to rebound from psychological perturbations, both in the context of critical incidents, terrorism, and mass disasters (Nucifora et al. 2007). However, similarities between constructs that frame resilience theory and research at the psychological level, as described above, and at the level of the social–ecological system (SES), suggest that research addressing the overlap between these two distinct bodies of work might lead to new perspectives or discoveries (Masten and Obradovic 2008, cf. Lundholm and Plummer 2010). One possibility, and that which we pursue in this paper, would be to explore whether tree planting and other greening activities known to foster psychological–social resistance and resilience might also be a source of SES resilience.

By SES resilience, we mean the potential of a system to remain in a particular configuration and to maintain its feedbacks and functions, involving the ability of the system to reorganize following disturbance-driven change (see also Plummer 2010; Walker et al. 2002). More specifically, our paper focuses on the idea of reestablishing SES resilience by community greening processes that contribute to system memory, processes involved in "regeneration and renewal that connect that system's present to its past" (Gunderson et al. 2002, p. 264). Expanding on work on ecosystem resilience, Adger (2000) suggests that learning, trust, and engagement are key components of social resilience. Further, Gunderson et al. (2002) state that social learning is critical to SES resilience, and is facilitated by recognition of uncertainties, by monitoring, and by assessment of the results of management actions by stakeholders.

Fundamental to this paper is the argument put forward by Berkes and Folke (1998) that systems that demonstrate resilience appear to have learned to recognize feedback, and therefore possess "*mechanisms* by which information from the environment can be received, processed, and interpreted" (p. 21, emphasis added). In this sense, these scholars go further than simply recognizing that people are part of ecological systems, but attempt to explore the means, or social mechanisms, that bring about the conditions needed for adaptation in the face of disturbance and other processes fundamental to SES resilience. One such social mechanism extensively documented by Berkes and colleagues is traditional ecological knowledge (Berkes 2004; Berkes, Colding, and Folke 2000; Berkes and Turner 2006; Davidson-Hunt and Berkes 2003; see also Shava et al. 2010). In this paper, we ask: What other social mechanisms might exist and how does one identify and describe these mechanisms in post-disaster scenarios?

We propose that the greening and civic ecology practices described in this contribution can be viewed as "tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience" (Berkes and Folke 1998, pp. 21–22). We draw on Berkes and Folke's (2002) argument that some SES build resilience through the experience of disturbance, but in order for this to occur sufficient memory in the form of both ecological and social sources for reorganization must be present. In particular, we focus on one type of memory that people often gravitate to with a sense of urgency in post-conflict and post-disaster situations, i.e., memories of how greening activities and stewardship lead to healing. Such greening activities are one form of memorialization, which has been described as:

> *the process of creating physical representations or commemorative activities that concern events in the past and are located in public spaces … designed to evoke a specific reaction or set of reactions, including public acknowledgment of the event or people represented; personal reflection or mourning; pride, anger, or sadness about something that has happened; or learning or curiosity about periods in the past.* (Brett et al. 2007, p. 1)

In post-conflict situations, we often observe a phenomenon called spontaneous memorialization, or "a rapid public response to publicized, unexpected, and violent deaths, typically involving the accumulation of individual mementos to create a shrine at the death site" (Roberts 2002, p. 569). Although community greening represents a more persistent memorialization, similar to spontaneously created shrines, it invites participation by anyone who wishes to express not only mourning over the deceased, but also grieving over the social pathologies that might have contributed to the conflict, disaster, and resultant deaths (Haney, Leimer, and Lowery 1997).

Harkening back to the questions raised about social mechanisms of SES resilience in post-disaster settings, in this paper we ask whether this acting on and manifestation of memories of healing through greening might represent a social mechanism not previously addressed in the resilience literature. Because this mechanism is associated with the act of memorializing those lost during the disaster or conflict, we refer to it as a memorialization mechanism.

Thus, in this paper we describe how memories of trees and other living things that have died or been left behind, or that in symbolic terms represents place, hope, life, and rebirth, seem to play an important role in resilience at multiple levels following

disaster. In so doing, we draw on two examples: the Living Memorials Project post-9/11, and community forestry in New Orleans following Hurricane Katrina. Through these examples, we explore a hypothesis that we hope will provoke further discussion and research: civic ecology practices, including urban community forestry, community gardening, and other self-organized forms of stewardship of green spaces in cities (Tidball and Krasny 2007), are manifestations of how social and ecological memories can be instrumentalized through social learning to foster SES resilience following crisis and disaster. Further we propose that civic ecology "communities of practice" (Wenger 2003; Wenger, Mcdermott, and Snyder 2002) that emerge within and across cities help to leverage these memories into effective practices, and that such communities of practice serve as urban iterations of the collaborative and adaptive management practices that play a role in SES resilience in more rural communities (Berkes, Colding, and Folke 2003b; Davidson-Hunt and Berkes 2003).

Collective memory, social learning, and resilience

Collective memory, a term first coined in 1925 by Maurice Halbwachs (c1925/1980), refers to representations of important shared experiences by social groups, ranging from families to communities to nations. They often form when groups encounter significant threats and adverse events or victories over adversity that get imprinted on the collective consciousness of a group (Kahana and Kahana 2006). Stories that contribute to collective memory may contribute to social dialog by assisting in the creation of common values among citizens (Osiel 1999). Such collective memories have been described by Emile Durkheim (c1933/1964) as collective conscience

because of their role in forming, maintaining, or reinforcing group identity. Shared values may emerge from collective memories and also shape how collective memories are represented (Sicher 2001).

Berkes' (2004) description of Cree hunters is consistent with notions of collective memories, and links such memories to SES resilience. In the early part of the last century, hunters, armed with newly available repeating rifles, slaughtered hundreds of caribou, following which the caribou herd disappeared from Cree hunting land.

Seventy years later, the caribou reappeared, but were slaughtered again by younger members of the community who did not have memory of the disastrous events two generations earlier. The following winter, meetings were called at which elders retold the story of the 1910 disaster. The elders' retelling of unethical hunting practices and subsequent collapse of the caribou herd led to more sustainable practices among younger Cree hunters (Berkes 2004).

According to Berkes, Colding, and Folke (2000), such collective memories play a role in the ability of an SES to respond to crisis, and thus may be one source of SES resilience. Further, when shared through social learning processes, such memories are particularly important after a major perturbation or disaster "flips" a system into a less desirable state, and the system is in the reorganization and rebuilding phase of Holling's (1973, 1986) adaptive cycle (Berkes and Folke 2002; see also Plummer 2010). In addition to social memories, ecological memories, such as seed banks and

remnant populations that provide the biological materials needed for recolonization of ecosystems, are critical in the rebuilding phase of the adaptive cycle. In the case of the Cree, remnant caribou populations in neighboring territory represented a form of ecological memory, which served as a biological reservoir for recolonization following earlier overhunting (Berkes and Folke 2002). Similarly, Gadgil, Hemam, and Reddy (1998) and Gadgil et al. (2003) have described how communities in more densely populated regions set aside sacred forests as a source of ecological memory (e.g., seeds, animals, and other forms of genetic material for recolonization in the event of a crisis).

In the case of the Cree, collective memories were transmitted through a number of social learning processes, including storytelling by elders, rituals, and ceremonies, as well as apprenticeships in which novices learn alongside more experienced resource users (e.g., hunters, fishermen). Through such processes, learning at the individual level became distributed throughout the community, and thus was scaled up to the level of communities, organizations, and institutions (Berkes, Colding, and Folke 2000).

Scholars of social learning have variously used the term to refer to learning that occurs through imitation of role models and social interaction (Bandura 1977) and through iterative feedback between learners and their environment resulting in changes in both (Barab and Roth 2006; Chawla 2008; Greeno 1998; Pahl-Wostl 2006). In the context of resource management, Pahl-Wostl et al. (2007) suggest that movements from individual “multiple cognitions” to interrelated “distributed cognition,” and to understanding of group processes, are required to fully understand social learning. Learning concepts applied beyond solely individuals to whole social entities can be

found in the field of organizational learning (Argyris and Schön 1996; Senge 1990; Wenger 1998a; see also Lundholm and Plummer 2010). As Pahl-Wostl et al. (2007) argue, such concepts emphasize the development of shared meanings and practices, often aimed at changing resource management policy (Blackmore, Ison, and Jiggins 2007). To these, we would add shared memories, which may form the bases for certain resource management practices, which in turn are shared and learned through a stewardship or civic ecology community of practice (Wenger, Mcdermott, and Snyder 2002).

In the context of natural resources management, Pahl-Wostl et al. (2007) further suggest that social learning results from an interplay among three elements: context formed by a given governance and physical system, process formed by the actual management practices, and a series of outcomes that feed back into the original context as changes in the institutional and environmental systems. Scholars of adaptive co-management (cf., Plummer 2009) emphasize these feedbacks or management outcomes in their definition of social learning as a collaborative process among multiple stakeholders aimed at addressing management issues in complex systems (Blackmore, Ison, and Jiggins 2007; Pahl-Wostl et al. 2007; Schusler, Decker, and Pfeffer 2003). Components of social learning that we find most relevant to the case examples below include engagement in communities of practice and feedback to other parts of the SES through actions to address problems that are identified during the learning process.

Given the importance of cities to global sustainability, exploring resilience processes not only in rural indigenous communities like the Cree, but also in urban SES is important. We contend that civic ecology practices, or people joining together with

neighbors to plant gardens and trees and otherwise restore small plots of land and watersheds in cities (Krasny and Tidball 2010; Tidball and Krasny 2007), can be a manifestation of linked social–ecological memory and when drawn on in times of crisis act as social mechanisms in SES resilience. Further, social learning that shares such memories may serve to foster adaptive capacity, which can be leveraged during the rebuilding phase post-disaster.

Greening examples from urban post-catastrophe settings

Though people do not have the ability to decide what is destroyed by a disaster, they do have the ability to decide what is reconstructed (Miller and Rivera 2007). Therefore, that which is reconstructed, like green spaces or an urban forest, symbolizes the cultural, social, and political ideals that the society values and wants to transmit (Baker 2003; Foote 1997), to which we add ecological ideals. We next present two examples of civic ecology practices appearing in red zones that exemplify the linkage between cultural, social, political, and ecological ideals, and provide evidence for our contentions about memory and learning. These examples draw on interviews conducted in confidentiality, and the names of interviewees are withheld by mutual agreement.

Living Memorials Project: greening responses to loss of life on September 11

The Living Memorials Project was created by the U.S. Forest Service at the request of Congress following the September 11, 2001, terrorist attacks in New York City (NYC). It was both a program to support the creation of landscape-based memorials as well as a research initiative to understand changes in the use and stewardship of trees and open space following the terrorist attacks. A total of 687 Living Memorial sites across the USA were mapped from 2001 to 2006, and interviews were conducted with

memorial stewards in 113 projects to better understand open space and community involvement as a response to disaster (Svendsen and Campbell 2005).

Living Memorials varied greatly in form, from single trees to small forests, from underwater seamounts to bonsai trees, and involving the rededication of existing natural or open space and the creation of new open space. They were planted on the grounds of cemeteries, town greens, hospitals, libraries, churches, homes, sidewalks, and existing community gardens; and honored individual victims as well as more generally the nearly 3000 who perished in the 9/11 terrorist attacks. Spatially, the greatest density of memorials was in the NYC metropolitan area, with other clusters along the eastern sea coast and California. In states that did not contain crash sites, the state capital or largest city commonly served as a memorial site. Living memorials generally reflected the resources, attitudes, lifestyles, and cultures that were endogenous to a place. Overall, when stewards were asked about the purpose of their living memorial, 25% said that they wanted to promote stewardship and community engagement, and 48% said they would hold events related to community stewardship and management at the site (Svendsen and Campbell 2005).

As the name Living Memorials implies, social and ecological memories were seen to blend in the act of memorializing loss. For example, the creator of the Sunflower Project in NYC related that:

> *The official September 11 memorial in New York City will not be in place any time soon. We felt something should be in place – not just at Ground Zero, but everywhere. There is a power and healing that comes with digging in the dirt, planting new life and nurturing its growth. It also grows community.*

> *Sunflowers are easy to grow, and brighten up the most forgotten, neglected places. Like New Yorkers, sunflowers are tenacious, surviving and thriving in adverse conditions. Sunflowers improve the ground and air where they grow, attracting birds and butterflies. They make sense as one tall way to remember life and make it a bit better – it's hard not to look up in their presence* (NYC resident and Sunflower project participant).

Several mechanisms emerged to foster social learning within and across Living Memorials sites. For example, in the Bronx, NYC, residents held a Sustainable South Bronx Living Memorial Trail Community Design Meeting to plan their site. The Living Memorials website facilitated learning across sites by posting descriptions and photographs of all sites across the US, as well as by creating a toolbox to assist individuals in navigating the social, biological, and physical challenges of developing a Living Memorial.

Figure 2.1. Corporate and community volunteers organized by the New Jersey Tree Federation plant memorial trees at the New Jersey Grove of Remembrance in Liberty State Park in Jersey City, NJ. Photo reproduced courtesy of Living Memorials Project National Registry.

Figure 2.2. Neighborhood residents participate in a community forestry street tree planting coordinated by Groundwork Yonkers in Yonkers, NY. © Erika Svendsen.

Figure 2.3. Volunteers from Greening for Breathing create the Living Memorial Trail in the Hunts Point neighborhood, Bronx, NY. Photo reproduced courtesy of Living Memorials Project National Registry.

New Orleans: trees and rebirth after Hurricane Katrina

Hurricane Katrina made landfall in New Orleans on 29 August 2005. New Orleans endured weeks of inundation and devastation, and months of disorganized recovery efforts. Yet despite media reports portraying New Orleans as paralyzed and helpless, or even worse descending into chaos, ordinary citizens were observed planting and caring for trees in neighborhoods across the city. Within four years after the disaster, three local NGOs, Parkway Partners, Hike for KaTREEna, and Replant New Orleans, worked with community volunteers and government agencies to plant over 6000 trees in hard hit areas. Interviews conducted by the first author (Tidball) with volunteers in the devastated 9th Ward and other New Orleans neighborhoods, and with leaders of local NGOs, revealed how trees and replanting trees were critical in bolstering people's resolve to rebuild their lives, and how memories of the live oaks and other trees that had been symbolic of New Orleans as a place to live became a symbol of hope for re-growth of the city and of their lives.

Figure 2.4. A tree marks the boundaries of home, all that remained after Hurricane Katrina destroyed most of the Lower 9th Ward in New Orleans. © Keith G. Tidball.

Echoing the learning through memory experiences of the indigenous communities observed by Berkes, Colding, and Folke (2000), some neighborhoods described the importance of their post-Katrina tree planting in terms of memories of errors in natural resource management from previous generations and the community's desires to learn from those mistakes. This was especially true in the neighborhood called Tremé, which was first developed in the early nineteenth century.

Claiborne Avenue bisects the Tremé neighborhood. Historically, Claiborne Avenue boasted a wide "neutral ground" lined with old and stately live oak trees, and the public green space is said to have been used as a community gathering place for the area's mostly African-American residents. The construction of an elevated highway through the Tremé neighborhood above the oldest section of Claiborne Avenue in the late 1960s is widely thought to be one of the most, if not the most, controversial development in the history of New Orleans, pitting residents of the French Quarter and preservationists against Tremé residents. After construction, poorly lit cement parking lots under the freeway replaced the grassy neutral ground, and concrete supports for the highway replaced oak trees. Construction of the overpass contributed to the overall decline of the Tremé neighborhood in the 1960s and 1970s (Rogers 2009). In 2002, as part of the Restore the Oaks art installation, the outer freeway columns were painted by artists to memorialize the live oak trees that once stood on both sides of Claiborne Avenue (see Figure 2.5, below).

After Katrina in 2005, residents of the Tremé neighborhood urgently and vigorously began planting trees. During interviews with members of post-Katrina tree planting groups in Tremé, it became clear that memories of the Claiborne Avenue highway

development and subsequent loss of trees and neighborhood function were playing a large role in present day post-Katrina actions.

Figure 2.5. Claiborne Avenue pillars painted with trees to commemorate loss of Live Oak trees during construction of the I-10 overpass. Photo courtesy of Jean Fahr, Parkway Partners, New Orleans.

A community elder recounted:

> *I am going to go further back (than Katrina) … We lost something … we had these big majestic oaks that city planning and everyone else saw fit to uproot. Along with those oaks we had inherited businesses. So that's the legacy that's lost. So, these trees (we are planting) might be a reminder of what we lost, so that we don't ever forget it and don't let that happen to us again, as well as kind of light a fire under us to ensure that we won't have to worry about a*

> *legacy being lost (due to Katrina).* (Tremé community member and tree planter, January 19 2009)

Another community elder related:

> *We remember, just about five short blocks from here, we have Claiborne Avenue, which was a beautiful corridor of oak trees that, it's unfortunate, but the government came through with the interstate, and they knocked all the trees down … it destroyed the neighborhood; by destroying two hundred or three hundred year old trees, they destroyed the neighborhood. We need to do the opposite of that.* (Tremé community leader and tree planter, January 19 2009)

Professional urban foresters corroborated these accounts of community members who seemed to invoke a kind of local knowledge in the planting of trees as a symbol of the broader rebuilding phase in New Orleans:

> *I know that efforts to repair and reconstruct the urban forest canopy of the communities affected by hurricanes Katrina and Rita have been an important aspect of recovery for individuals in our area. The ability to help in these efforts by direct involvement, be it planting activities or whatever, has been important to give people the feeling that they have a contribution to give. But, I know this on an anecdotal level. There is no research that attempts to quantify or verify this important sense of stewardship that has arisen in our populace. Members of our community that direct these types of activities know this and have responded with vigor to afford people the opportunity to be involved.*

> *Disaster recovery officials however do not seem to have this on their radar. This is an important breakdown that, hopefully, can be addressed.* (Professional Urban Forester, Louisiana)

Volunteers participating in the tree planting events were able to learn from each other and from more experienced tree planters. For example, the NGO Parkway Partners trained citizen "Tree Troopers" to aid in the replanting and tree care efforts. Similar to what occurred in the Living Memorials Project, opportunities for cross-site learning were created, as when trained Tree Troopers were called upon to go to other neighborhoods to train additional tree planters. Tree Troopers spoke of how sharing their skills contributed to the rebuilding of New Orleans:

> *I have taken trees and so many other things for granted before the storm; I guess you don't appreciate what you have until it is gone. Planting trees now will give future generations an environment they can appreciate and makes me feel like a part of something way bigger than myself.* (Parkway Partners Tree Trooper volunteer, May 19 2009)

Memory in civic ecology practices post-disaster

Similar to memory and learning within the context of adaptive management in rural and indigenous communities (Berkes, Colding, and Folke 2000), in these urban post-disaster settings, community members acted on individual and collective memories of stewardship practices and their impacts, and shared their actions through processes of social learning. Further, similar to the remnant caribou populations of the Cree, the community gardens and other green spaces that were present prior to 9/11 and were converted into Living Memorials, as well as trees that survived the New Orleans

hurricanes and served as a source of biological material for tree growth and replanting, constitute a kind of ecological memory. However, a number of important differences exist between the management practices, memory, and learning in the rural examples from the literature and these urban post-disaster scenarios.

Examples in the social–ecological resilience literature focus largely on communities that directly depend on natural resources for their livelihoods, whether they be hunting communities in northern Canada (Davidson-Hunt and Berkes 2003) or fishing communities in Southeast Asia (Armitage, Marschke, and Plummer 2008). In these settings, memories held by elders and knowledge held by experienced resources users play an important role in managing the wildlife or fisheries resources. In the urban settings, memories of specific planting practices may come from engaging in such practices prior to disaster, or from before urban residents moved to the city. Many urban residents are migrants from rural areas of the USA or immigrants from developing countries to the USA (Dodson and Diouf, n.d.; New York City Department of City Planning 2004), and may hold memories of farming from their childhood. Further, even though urban residents are not dependent on gardens or trees for their livelihoods, they still may have a positive psychological dependence on green spaces (Stedman and Tidball 2008; Ch. 5 this volume) as would be suggested by research cited earlier on the role of greening in psychological resilience (Taylor et al. 1998; Taylor, Kuo, and Sullivan2001; Ulrich 1983).

However, in describing social mechanisms for feedback that is critical to SES resilience, we are not only interested in the memories of agricultural or resource management practices per se. Rather we are interested in the role of memorialization,

evidenced in a kind of spontaneous or "urgent" return to greening, as one component of a social feedback mechanism that also includes social learning (see below).

Drawing on the notion of biophilia put forward by E.O. Wilson (1984), Tidball (see Chapter 3, this volume) has coined the term "urgent biophilia" to suggest that greening as a post-disaster response may be in part attributable to human evolutionary memory, or a genetic and culturally learned affinity of humans for other living beings. While acknowledging the provocative nature of any claims about biophilia (Allen et al. 1975; Lewontin, Rose, and Kamin 1984; Segerstråle 2000), we find the notion that stewardship of green spaces might be in part an expression of evolutionary memory in humans useful in explaining these spontaneous and self-organized stewardship behaviors post-trauma. The notion of urgent biophilia may play a role in resolving contradictions resilience scholars face in trying to integrate social and ecological processes related to memory at multiple scales (Gunderson, Holling, and Light 1995). Because humans are organisms, by focusing on human evolutionary memories, we may be able, at least heuristically, to blur the distinction between social and ecological memories; in other words, an urgent biophilic memory suggests an integration of human (social) and ecological/biological (genetic) processes.

Social learning in post-disaster civic ecology practices

According to Wenger (1998b), communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavor. Such an endeavor may be subsistence hunting among indigenous communities or civic ecology practices in cities, both of which can be viewed as forms of adaptive and collaborative management. Put another way, communities of practice are groups of people who share practice and who learn how to improve and expand that practice as

they interact regularly. A community of practice defines itself along three dimensions (Wenger 1998b): its joint enterprise as understood and continually renegotiated by its members (in our case, gardening and tree planting as response to disaster); mutual engagement that binds members together into a social entity; and shared repertoire of communal resources that members have developed over time (in our examples, the spaces and living things within the spaces, including live oak seedlings and trees, symbolism around these trees, experiences, ideas, stories, memories, tools, commitments, and ways of addressing recurring problems (Smith 2003, 2009; Wenger 1998a). Communities of practice can be seen as self-organizing systems and share many of the benefits and characteristics of associational life, such as the generation of social capital (Putnam 2000; Smith 2003, 2009). Learning can be the reason the community comes together and thus be intentional, or an incidental outcome of members' interactions. The Living Memorials and New Orleans post-disaster greening communities of practice are not intentionally designed around learning. Rather, they begin when people gravitate, often urgently and spontaneously, toward a greening response to disaster. Learning at first is unintentional, occurring largely through informal observations and social interactions. With time and more formal development of these post-disaster communities of practice, learning may become more formalized, as in the New Orleans example of volunteer Tree Troopers being trained and helping others to plant trees. Other types of learning may occur, for example, about the power of collective action to protect community gardens and trees in the face of subsequent commercial, highway, and other forms of economic development. This learning, as well as learning about the trees and the ecosystem services that they provide, has important implications for designing environmental education programs that are situated in stewardship practice (Krasny and Tidball 2009b; Krasny, Tidball, and Sriskandarajah 2009; see also Krasny and Roth 2010).

The Living Memorials and New Orleans tree planting and greening communities of practice are important not only for the learning that occurs among participants in these communities, but also for the potential impact this learning has on the larger SES. The process starts with an urgent or spontaneous desire to plant gardens or trees, perhaps due to an individual or collective memory, initiated in some cases by a symbolic process in the form of a memorial or a related social memorialization mechanism. Next, through the social learning processes of observing and sharing practice and reflection, members of the gardening or tree planting community of practice expand their shared repertoire from planting to encompass advocacy and an understanding how they, as humans, can enhance local biological diversity and ecosystem services. In using this learning to inform their planting and broader environmental and civic engagement practices, it becomes a source of feedback to the larger Living Memorials or urban community forestry system, suggesting new ways in which NGOs, volunteers, and governments might adapt their management practices. Such feedback is a critical component of adaptive management (Berkes, Colding, and Folke 2003b) and a source of SES resilience (Walker and Salt 2006). Thus, through facilitating adaptive management process, as well as through the social connectedness that builds among the tree planters and greeners, these processes may confer resilience on the urban SES (Pahl-Wostl et al. 2007; Tidball and Krasny 2008). It is possible that in some cases, the critical role of this greening memorialization mechanism and related civic ecology practices, not only in healing post-disaster but more broadly in fostering urban sustainability, are being recognized by NGOs and government leaders well beyond the original spontaneously formed communities of practice (for example, in the MillionTreesNYC tree planting initiative, PlaNYC 2009).

Conclusion: social learning and environmental education

Given the importance of both social and ecological memories in allowing an SES to "exercise problem-solving skills, innovate, and adapt" in the face of catastrophic and other forms of change (Berkes, Colding, and Folke 2003a), and that a collective memory making process ensues following disaster to frame and historicize what has just occurred (Neal 1998), we have set out to explore the role of memory in post disaster settings. In particular, we have examined how a recollection that the decision to turn to stewardship activities like community gardening and community forestry will increase individual and community well-being, is acted on, and becomes a source of both psychological–social and SES resistance and resilience following disaster.

Further, we have suggested that civic ecology practices are manifestations of how social and ecological memories can be instrumentalized through social learning and communities of practice to foster SES resilience following crisis and disaster. Finally, we have proposed that civic ecology communities of practice serve as urban iterations of the collaborative and adaptive management practices that play a role in SES resilience described in more rural communities (Berkes, Colding, and Folke 2003b; Davidson-Hunt and Berkes 2003).

According to Carpenter and Gunderson (2001), "education at many levels, ranging from K-12 environmental education to outreach programs for adults, may contribute to the collective learning or social flexibility needed for adaptive management" (p. 457).

However, in contrast to extensive scholarship on memory and social learning, the role of more formal education has not been widely explored in the resilience literature (for exceptions, see Krasny and Tidball 2009a, 2009b; Krasny, Tidball, and Sriskandarajah 2009). One explanation for this gap may be that formal education practices often contradict the self-organization, multiple forms of knowledge and governance, and other tenets of the resilience framework (see Plummer 2010). However, in a democracy, not only the direct resource users but also citizens far distant from the resource have a voice in determining resource management practices. Furthermore, in urban and other more populated landscapes, learning as part of ongoing practice, such as occurred in the case of the rural Cree, may only be possible as part of an educational intervention that brings together youth with knowledgeable elders.

The self-organized stewardship communities of practice described here may provide a context for engaging young people in learning through informal participation and more formal environmental education programs (Krasny and Roth 2010; Krasny and Tidball 2009b; Sriskandarajah et al. 2010), and thus help to transmit memories of greening as a source of healing, which in turn become a mechanism for conferring SES resilience. Although largely absent from the literature on individual-level resilience in children (see, e.g., Clauss-Ehlers and Weist 2004; Waller 2001), evidence from studies reviewed by Louv (2006) suggests that opportunities for children to engage in nature stewardship alongside more experienced adults could promote both children's and adult's emotional well-being as well as environmental learning and stewardship. In short, such stewardship-based environmental education programs

would be expected to foster SES resilience indirectly through building the agentive capacity and technical skills of participants, and directly through participants' stewardship actions leading to increased red zone ecological service provision. Thus, future work on civic ecology and resilience in red zone contexts may consider expanding a focus on social and ecological memories and adult social learning to incorporate educational programs that engage youth in these greening, or adaptive co-management, communities of practice.

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CHAPTER 3

PAPER II- URGENT BIOPHILIA: HUMAN-NATURE INTERACTIONS AND BIOLOGICAL ATTRACTIONS IN DISASTER RESILIENCE

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Abstract

This contribution builds upon contemporary work on principles of biological attraction as well as earlier work on biophilia while synthesizing literatures on restorative environments, community based ecological restoration, and both community and social-ecological disaster resilience. It suggests that when humans faced with a disaster, as individuals and as communities and populations, seek engagement with nature to further their efforts to summon and demonstrate resilience in the face of a crisis, they exemplify an urgent biophilia. This urgent biophilia represents an important set of human-nature interactions in SES characterized by hazard, disaster, or vulnerability, often appearing in the "backloop" of the adaptive cycle (Holling and Gunderson 2002). The relationships that human-nature interactions have to other components within interdependent systems at many different scales, may be one critical source of resilience in disaster and related contexts. In other words, the affinity we humans have for the rest of nature, the process of remembering that attraction, and the urge to express it through creation of restorative environments, which may also restore or increase ecological function, may confer resilience across multiple scales. In making this argument, the paper also represents a novel contribution to further theorizing alternatives to anthropocentric understandings of human-nature relations, and strongly makes the case for humans as part of, not separate from, ecosystems.

Key words: biological attraction, biophilia, urgent biophilia, disaster, human-nature interaction, resilience

Introduction

Can community-based ecological restoration, sometimes referred to as human-nature interactions or greening, help us begin to understand the importance of biological attraction principles in resilience thinking, especially in areas that have experienced hazards and disasters? We know that human societies have been beset with hazards and disasters for thousands of years (Diamond 2005; Reilly 2009), and have had to adapt to survive them. We have also seen how interactions among humans and other biophysical elements of social-ecological systems play a role in recovery and resilience after surprise and rapid change brought about by geophysical, technological, political, or other disasters (Tidball and Krasny in press). Thus, disasters provide "a unique view of a society's capacity for resistance or resilience in the face of disruption" (Oliver-Smith and Hoffman 2002, p. 10), and a lens through which to observe the importance of human-nature interactions and biological attractions in these contexts.

In the 21st century, some argue that humans are now bringing about disasters in unprecedented scope and scale (Oliver-Smith 2002; Zhang, Brecke et al. 2007). A few decades ago, Lewis and Sturgill (1979) warned that humans are living in "two worlds… within the envelope of our skin is a biological entity which, through evolution, has been tuned for survival in natural environments…[yet] around us lies not the green world in which we learned to survive and carry forward our species, but rather a world of our own creation, built of inert materials," alluding to the

possibilities of disasters born, in part, of our own short-sightedness. More recently, Gibbs (2009) reminded us that "it is the events that are not well foreseen and therefore not perceived to be a threat that are likely to expose a lack of resilience… [t]hus, it is the large and often unforeseen perturbations that can expose resilience" (p. 329).

So, do we remember in some way the lessons of Lewis and Sturgill's green world and deploy that memory when confronted with catastrophe (Tidball, Krasny et al. 2010)? I have argued, along with many colleagues, (Tidball and Krasny in press),that human-nature interactions may represent a suite of human adaptations to hazards and disasters, including geophysical events, war, acts of genocide or persecution, among others (Vayda and McCay 1975; Hoffman and Oliver-Smith 2002), and that applying observations from both the literature on resilience in human development (Masten, Best et al. 1990) and the literature on resilience in social-ecological systems (SES) (cf. Walker, Holling et al. 2004 among many others) may be useful in addressing diverse massive-scale hazards, such as a flu pandemic, ethnic conflict and war, or natural disasters, where interdependent adaptive systems at multiple levels, from cellular to global, face destruction (Masten and Obradovic 2008). By explicitly integrating these linked notions of resilience and vulnerability, this paper attempts to address the continued lack of integration regarding insights around adaptation and transformation from unique scientific approaches (Miller, Osbahr et al. 2010) while contributing to the literature connecting individual resilience to the adaptive functioning of larger social systems and networks, such as neighborhoods or socio-cultural systems, which, as Masten and Obradavic (2008) have pointed out, is scarce.

In this paper, I propose a nuanced addition to the idea of biophilia (Wilson 1984; Kellert and Wilson 1993). By augmenting biophilia with new ideas about biological attraction (Agnati, Baluska et al. 2009), I suggest that when humans faced with urgent disaster or hazard situations, as individuals and as communities and populations, seek out doses of contact and engagement with nature to further their efforts to summon and demonstrate resilience in the face of a crisis, they exemplify an urgent biophilia. This urgent biophilia represents an important set of human-nature interactions in SES experiencing hazard, disaster, or vulnerability, often appearing in the "backloop" (see Figure 3.1) of the adaptive cycle (Holling and Gunderson 2002). The relationships those human-nature interactions have to other components within interdependent systems at many different scales, may be one critical source of resilience after dramatic surprise or sudden change. In other words, the affinity we humans have for the rest of nature, the process of remembering that affinity and the urge to express it through creation of restorative environments, which may also restore or increase ecological function, may confer resilience across multiple scales. Through this expression of perhaps "humanity's single most powerful idea- that we are not at the center of anything…and also our most humbling idea, that all of life on earth is kin" (Krishtalka 2009, p. 16) we may find important insights into the value of human – nature interactions beyond those that become highly visible in hazard, disaster, and vulnerability contexts. This paper is not based primarily on empirical evidence, rather, on a combination of literatures attempting a transformative theory.

Background and context

It is certainly true that personal safety and security are of paramount concern in hazard and disaster contexts, as are basic and fundamental services like food and water

supplies, medical support, and basic infrastructure function (IFRC 2004). It is also well known that post-disaster planning brings its own set of challenges (Tidball, Weinstein et al. 2008; Tidball and Weinstein 2011). Like other events that radically affect communities (e.g., closing of a factory in a manufacturing town, see Stedman and Ingalls in press), disasters are known to exacerbate existing inequalities (Peacock, Morrow et al. 1997; Pelling 2003; Wisner, Blaikie et al. 2003; Drennan 2007). Sudden disasters often destroy the physical infrastructure of marginalized or vulnerable communities (Adger, Hughes et al. 2005; Daniels, Kettl et al. 2006) and can severely strain social networks (Walker and Meyers 2004). Furthermore, survivors of the disaster experience considerable psychological trauma that is difficult for responders to fully understand or skillfully negotiate (Sattler, Freedy et al. 1997; Inter-Agency Standing Committee 2007). In light of these challenges, it is remarkable how often one hears of stories where people have had an almost immediate "green response" to a crisis – forming a community garden in the case of war veterans and widows in Bosnia (Brdanovic 2009), growing a few flowers in the trenches of World War I (Helphand 2006), or tending to trees that survived in Hiroshima at the end of World War II (Cheng and McBride 2006).

Despite the obvious survival implications of planting food and tending trees, given the hardships and urgent safety issues faced by civilians, soldiers, and first-responders after a disaster or during war, it seems to some counter-intuitive that they would engage in the simple act of gardening, tree planting, or other greening activities. Yet, intriguing and compelling examples exist of people, stunned by a crisis, benefitting from the therapeutic qualities of nature contact to ease trauma and to aid the process of recovery (Miavitz 1998; Hewson 2001). A large literature explains the benefits of horticulture therapy more generally (Markee and Janick 1979; People Plant Council

1993; Relf and Dorn 1995; Relf 2005), as well as in more specific contexts such as among returning war veterans (Helphand in press; Krasny, Pace et al. in press), in refugee contexts (Moore in press), and in prisons (Lindemuth in press) to name a few. Beyond the therapeutic value of plants themselves, others have researched the value of green places, or restorative environments (Hartig and Staats 2003) to ease trauma or discomfort (Ulrich 1983; Kaplan and Kaplan 1989).

But what might tree planting, habitat restoration, community gardening, and other greening activities contribute to individual or SES resilience in hazard, disaster, and vulnerability contexts? In much of the research and practice conducted under the rubric of horticultural therapy, the individual person in need of an intervention is considered a patient who is prescribed horticultural interventions by a professional practitioner. Moving toward an "ecological" approach, researchers in the field of systemic therapies have proposed alternative strategies for healing, conducted in creative ways in nature, that address the environment not merely as a setting but as a partner in the process (Berger and McLeod 2006). In the context of SES resilience with its focus on emergent or self-organized processes, the attempt here is to move one step further towards linking consideration of individuals with consideration of groups of people, neighborhoods and communities, who find contact with nature of their own volition, a self-administered therapy, as a means to cope with the aftermath of a disaster, crisis, or conflict. In so doing, I hope to contribute to the literature connecting individual resilience to the adaptive functioning of larger social systems and networks, such as neighborhoods or socio-cultural systems (Masten and Obradovic 2008).

If it is true that, at least in the short term, "all disasters are local,"(Ganyard 2009) and that, similarly, as Masten and Obradavic (Ibid.) have argued, "all human resilience is

local, emerging from the actions of individuals and small groups of people, in relation to each other and powered by the *adaptive systems* of human life (emphasis added) and development," then we must look to that which human life has adapted to for clues about sources of emergent human resilience. Humans have adapted to both larger and smaller living systems and sub-systems with which we share interdependence, and according to both E. O. Wilson (1984) and Luigi Agnati and colleagues, we seem to have an affinity for those living systems (and arguably they to us), as will be discussed later in this paper. At the same time, some scholars claim that "there is substantial evidence to suggest that, as a species, our modern lifestyle may have strayed too far from that to which we have adapted" (Gullone 2000, p. 315). Masten and Obradavic (2008) acknowledge that a variety of systems facilitate human resilience, especially in post-disaster and related contexts, but seem to agree with Longstaff (2005) that those systems are unlikely to be directly available during an unfolding disaster. Their description of these systems includes primarily manufactured ones, such as communication, transportation, manufacturing, and others, and not ecological systems. But what if we included in this list of systems that facilitate resilience, especially after a disaster, locally available biological and ecological systems, subsystems and components, from the smallest to the largest, from the most simple to the most complex? After all, at least according to Kurakin (2009, p. 5), "the structures and dynamics of all living organizations, from proteins and cells to societies and ecologies, embody their evolutionary histories [and] memories." And what if, in terms of human resilience, we focused on the nearly scale-free property of life itself, of the compulsion to live, of living (Kurakin 2007; Agnati, Baluska et al. 2009)?

At this point, it is important to briefly operationalize two terms that appear frequently in this chapter, greening and resilience. When speaking of greening, I refer to an active and integrated approach to the appreciation, stewardship and management of living elements of social-ecological systems. While recognizing the importance of green political thought and of a growing interest in a "green economy" (Pearce, Markandya et al. 1992; Milani 2000), in this paper the focus is on initiatives that emerge in a context of self-organized community development and community-based ecological restoration. In fact, perhaps a significant accomplishment of such locally emergent greening practices, in particular the more participatory forms embodied in many community gardens in large cities (Schmelzkopf 1995; Saldivar and Krasny 2004) and in tree planting efforts in neighborhoods of post-Katrina New Orleans (Tidball, Krasny et al. 2010), is the mainstream acceptance of much of green political thought[1]. The philosopher Andrew Light (2003) has captured this notion in his description of how environmental stewardship efforts are defining a new environmental movement; this civic environmental movement finds its inspiration in the work of urban "community greeners."

This chapter will not be dealing in much depth or detail with political or philosophical dimensions of greening, nor delve solely or too deeply into the broad field of horticulture, which concerns itself with growing plants in cities for ornamentation and other purposes (Tukey 1983). Rather than focus strictly on utilization of plants, the emphasis here is upon active cultivation within a social-ecological or community context, going beyond the ornamental and instrumental uses of plants and nature to

[1] For an overview of green political thought, see http://www.greenparty.org/ and http://www.global.greens.org.au/charter/10values(us).html

suggest that human relationships with plants, animals, and landscapes have a role to play in urban and other settings faced with hazard, disaster, or vulnerability.

Scholars writing about SES resilience have identified four factors as critical to fostering resilience during periods of change and reorganization: (1) learning to live with change and uncertainty; (2) nurturing biological and cultural diversity; (3) combining different types of knowledge for learning; and (4) creating opportunity for self-organization (Folke, S. Carpenter et al. 2002). In previous work my colleague and I have proposed the term "civic ecology" (Tidball and Krasny 2007; Krasny and Tidball 2012) and associated "civic ecology practices" (Krasny and Tidball 2010) to describe community-based greening efforts which address these and other factors fostering SES resilience. We define civic ecology as the study of feedbacks and other interactions among four components of a SES: 1) community-based environmental stewardship (civic ecology practice); 2) education and learning situated in these practices (civic ecology education); 3) the people and institutions involved; and 4) the ecosystem services produced by the people, their stewardship, and educational practices (Tidball and Krasny 2007; Tidball and Krasny 2011). Civic ecology practices integrate local stewardship activities, such as planting community or allotment gardens or monitoring local biodiversity, with learning from multiple forms of knowledge including that of community members and scientists or other experts. Such practices often lead to civic activism such as advocating for green spaces as a means to reduce crime and violence. From the perspective of greening in hazard, disaster, and vulnerability contexts, civic ecology emphasizes creating conditions whereby existing community assets can be leveraged to foster SES resilience prior to and following hazard, disaster, and vulnerability scenarios in cities and in other SES.

Thus, it is in examining people's efforts to navigate journeys of resilience through urgent circumstances that we explore individual and community yearning for and subsequent expression of an affinity for other living things. These doses of nature go beyond simply nature contact (Louv 2005) to encompass active engagement in restoring nature in concert with other members of one's community, for example through urban community forestry and community gardening. I acknowledge claims that not all people recognize or act upon this affinity for nature, and for those that do, such reactions may vary according to circumstance (Kellert 1997a).

Following Kellert in his book Building for Life (2005) and taking his ideas a step further into the realms of recovery and resilience post-crisis, in this paper I explore how expressing biological attraction through creating restorative environments might usher in and reinforce "… a respect for all values and benefits we derive from nature…" thereby reflecting "…a dependence [upon living systems] that extends far beyond a narrow materialistic and economic calculus to embrace a broader conception of human self-interest" (p. 180). This would enable recognition of "the widest range of values derived from our dependence on nature, one that also includes emotional connection, intellectual competence, the experience of beauty, a sound moral compass, and a world of enduring meaning and relation" (ibid). Based on my personal experience, too often recognition of these values, and opportunities to express them, are in short supply in hazard, disaster, or vulnerability contexts.

In order to build the argument about the importance of human-nature interaction in post-disaster or hazard recovery and resilience I briefly review the literature on restorative environments, biophilia, and biological attraction principles, and deploy these notions in terms of social-ecological interventions and responses in disaster

settings. After briefly exploring linkages between the concept of biological attraction and the notion of cultivating resilience, I turn to the SES resilience literature as it applies to expressing biological attraction in disaster and conflict scenarios. I conclude with a synthesis in which a hypothesis about the importance of urgent biophilia as it relates to SES resilience is forwarded. Given that this contribution is intentionally exploratory rather than data-driven, the intent is to stimulate thinking about the origin and role of greening in building adaptive capacity during and after conflict or disaster, rather than to present results of studies attempting to prove this phenomenon, though I hope such studies will be forthcoming.

Restorative environments

Though some scholars see human interaction with the landscape, such as gardening, as a form of human dominance over nature (cf., for example, Riley 1992), I have chosen to set aside such arguments that I feel may reinforce unhelpful dichotomies regarding humans and nature, and that may exacerbate the problems of human exemptionalism and exceptionalism that one might argue are underlying causes for hazards, disasters, and human vulnerability. Rather, I turn to Frumkin (2001) and Hartig (2007) who have traced the idea of human-nature relationships as contributing to human health from the writings of the ancient Greeks, to the New England transcendentalists (Nash 1982; McLuhan 1994; Murphy, Gifford et al. 1998; Mazel 2000), and through the American landscape designers Andrew Jackson Downing (1869) and Frederick Law Olmsted (1865/1952). Frumkin (2001) relates to us how, a century ago, the early American conservationist John Muir observed, “thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life” (Fox 1981, p.

116). Similarly, Hartig (2007) traces theories about how some natural environments promote restoration and in turn the health of individuals and populations to the writings of Andrew Jackson Downing (1869) and Frederick Law Olmsted (1865/1952).

Hartig and Staats (2003) noted that the idea of restorative environments has caught the attention of increasing numbers of environmental psychologists, as well as researchers in the environment–behavior–design (Betrabet 1996; C. Cooper Marcus and Barnes 1999) and public health fields (e.g. Frumkin 2001; King, Stokols et al. 2002; Svendsen and Campbell 2005a). According to Hartig and Staats (2003), the study of restorative environments complements research on the conditions in which our functional resources and capabilities diminish, such as what I refer to as "red zone" contexts like natural disasters and war (Tidball and Krasny in press). Hartig and Staats (2003) argue that this complementarity has theoretical and practical aspects; the theoretical aspect involves specifying those qualities of person-environment transactions that promote restoration (precedents acknowledged by Hartig and Staats in this effort include work by Berlyne (1960), Driver and Knopf (1976), Kaplan and Kaplan (1989), Kaplan and Talbot (1983) and Ulrich (1983)). Hartig and Staats (2003) call for further work that would reinforce the understanding that an absence of those demands or conditions that make a red zone a red zone (massive numbers of casualties or deaths, large scale damage to landscapes and ecosystem properties and functions, etc.), were that possible, would not necessarily make for an optimal restorative environment. In practical terms, they argue that the elimination of physical, social and temporal conditions that impose unwanted demands, red zone conditions if you will, does not necessarily leave us with a restorative environment. Rather, Hartig and Staats (Ibid.) claim that, following the lead of Frederick Law Olmsted, planners, landscape

architects, land managers, public health workers, politicians and others can make efforts to modify, maintain, and regulate environments so that they not only present fewer unwanted demands, but also have physical, social, and temporal characteristics that promote restoration (see e.g. Brett, Bickford et al. 2007).

More recently, studies (Hartig and Staats 2006; Van Den Berg, Hartig et al. 2007; Bell, Hamilton et al. 2008) have shown that the ability to see or actively experience green spaces can, among other things, reduce domestic violence, quicken healing times, reduce stress, improve physical health, and bring about cognitive and psychological benefits in individuals (Ulrich 1984; Kaplan and Kaplan 1989; Hartig, Mang et al. 1991; Sullivan and Kuo 1996; Faber Taylor, Wiley et al. 1998; Wells 2000) and populations as a whole (Hartig, Mang et al. 1991; Branas, Cheney et al. 2011). For example, a recent 10 year study has indicated that greening may reduce certain crimes while promoting some aspects of health (Branas, Cheney et al. 2011). Despite some claims that green spaces can be perceived as dangerous (Herzog and Flynn-Smith 2001; VanWinsum-Westra and Boer 2004), Maas and colleagues (2009) concluded that green space in people's living environment is generally associated with enhanced feelings of social safety and that this relationship is concurrent with the positive relationship between green space and people's health that has been found in the literature. Kuo et al. (1998) and Kuo and Sullivan (2001) present research demonstrating that exposure to trees in urban settings can foster a sense of safety and reduce crime rates, thus contributing to social well-being. Therefore, considering the voluminous research reviewed above, the “seeing green” implications for human health and well-being of so-called “plant-people interactions” (Salick 1995; Elings 2006; Relf 2006) appear to be well documented.

But is there more to this story than the value of seeing green? What about doing green? Most relevant to my interests, and building on research on restorative environments (Ulrich 1983; Ulrich 1984; Kaplan and Kaplan 1989), Helphand (2006) claims that the act of gardening historically has been a means for soldiers and victims of war to fight back for their own mental well-being, and for the disenfranchised to become involved in acts of defiance resisting "not only environmental difficulty but also social, psychological, political, or economic conditions." This is consistent with what my colleagues and I have argued elsewhere, that civic ecology practices, including urban community forestry, community gardening, and other self-organized forms of stewardship of green spaces in cities (Tidball and Krasny 2007), are manifestations of how social and ecological memories can be instrumentalized through social learning to foster SES resilience following crisis and disaster (Tidball, Krasny et al. 2010). We proposed that civic ecology communities of practice (cf. Wenger, McDermott et al. 2002; Wenger 2003) that emerge within and across red zones help to leverage these social-ecological memories (Barthel, Parker et al. in press) into effective practices, and that such communities of practice serve as urban iterations or analogs of the collaborative and adaptive management practices that play a role in SES resilience in more rural communities (Berkes, Colding et al. 2003; Davidson-Hunt and Berkes 2003). Others have also highlighted various values of doing green for enhancing human health and well-being (Miles, Sullivan et al. 1998; Austin and Kaplan 2003; Ryan and Grese 2005); many examples of this are to be found in the forthcoming edited volume Greening in the Red Zone (Tidball and Krasny in press).

A question may arise at this point about the availability of the benefits of seeing green and doing green to more than just individual humans. Although therapy, rehabilitation,

and restorative environments involve focusing on the specific needs of individuals, and working with the restorative environments proximate to individuals can serve the goals of therapy or rehabilitation (Cimprich 1993), Hartig (2007) argues that by focusing on recurring human needs for restoration:

…our scope of application opens to the population (italics added) and, as with other public health interventions, changes the living environment of that population. It is not necessary to work with each and every individual in the population in some deliberate way. Improving the availability of settings that support restoration can have positive effects on the health of the population as a whole, if not on every individual within the population... Especially in the urban areas where populations have increasingly concentrated, we can promote the health of people by providing opportunities to quickly, easily and regularly access places that support restoration, including but not limited to gardens, parks and forests (p. 4).

This movement from the individual to the community or even the population level, is echoed in the social science sphere by Granovetter (1973), who in stating "personal experience of individuals is closely bound up with larger-scale aspects of social structure, well beyond the purview or control of particular individuals" (p. 1377), provides further impetus for exploring the role of greening activities at the community and larger scales in hazard, disaster, and vulnerability contexts. Further elaboration and analysis of this scaling up to the community level of the benefits of green space is found in two recent studies of green space in Stockholm (Barthel, J. Colding et al. 2005; Ernstson, Sörlin et al. 2008).

Biophilia and biological attraction principles

Documentation of notions of the benefits of "seeing" or "doing green" can be traced to the aforementioned early works of Stephen and Rachel Kaplan (1989) and Roger Ulrich (1983; 1984) in restorative environments, and seem to resonate with Wilson's (1984) biophilia hypothesis in which he suggests that biophilia describes the connections that human beings subconsciously seek with the rest of life. This biophilia idea is an important reflection of broader efforts to correct what many argue are mistaken assumptions about the origins and ramifications of human dominance in the biosphere. In this domain, Wilson and his colleagues accomplished two things. First, they identified a phenomenon, i.e., that humans have an affinity for other living things. Second, they proposed the possibility that the phenomenon of humans having deep affiliations with nature is rooted in our biology (Kellert and Wilson 1993). These two observations should not be surprising given our evolutionary past, a past in which we evolved with the rest of the biosphere, not separate from it or exempt from its laws, and may be useful in efforts to escape the problems and traps of the human-nature dichotomy and the mythology of human exemptionalism and exceptionalism (Dunlap 1980; Dunlap and Catton Jr 1994; Vitousek, Mooney et al. 1997; Williams 2007). The connection between Wilson's biophilia hypothesis and the work of the Kaplans and Ulrich is explicitly made by Ke-Tsung (2001), who argued that both Ulrich's and the Kaplans' theories are based on an evolutionary perspective. Wilson's hypothesis has been acknowledged (Born, Lenders et al. 2001) to have found empirical support (for example, Kaplan 1995; Kahn 1999). Gullone (2000) argues that the research related to

biophilia to date is consistent with the proposal that predispositions that evolved in our ancestral environment continue to be present today despite their apparently more limited relevance for modern humans. Further, as Masten and Obradavic (2008) remind us, "the adaptive systems for positive human adaptation and development, legacies of biological and cultural *evolution (*italics added), must be considered and enjoined to promote resilience."

Wilson's (1984) notion of biophilia provides an early attempt at explanation for the restorative value of nature contact. First used by Erich Fromm (1964) to describe a psychological orientation of being attracted to all that is alive and vital, the term, and the book by the same name, attempted to shed light on "how the human tendency to relate with life and natural processes might be the expression of a biological need" (Kellert 1993, p. 20). Wilson suggested the possibility that the deep affiliations humans have with nature are part of our evolutionary past. As opposed to phobias, which are the aversions and fears that people have of things in the natural world, philias are the attractions and positive feelings that people share with certain habitats, activities, and objects in their natural surroundings. Wilson elsewhere argued that some behaviors are at least partly inherited and can be affected by natural selection, and that these behaviors have evolved over time, similar to the way that physical traits are thought to have evolved (Wilson 1975). This sociobiological perspective has been hotly contested since its initial presentation by Wilson and his colleagues (Allen, Beckwith et al. 1975; Lewontin, Rose et al. 1984; Segerstråle 2000).

It is important to note that Wilson and others describe both an innate and a learned component of biophilia, suggesting that biophilia develops through a process of gene-

culture evolution (Sideris 2003). Kahn (1997) points out that Kellert and others seem to argue that while evolutionary biology has an important place, "it should not be construed as rigid or deterministic, but rather as setting loose parameters in human lives" (p. 11). So for example, biophilia suggests that humans may have an innate tendency to spend time tending plants, but this tendency is reinforced culturally through watching and then helping parents and other older, more experienced members of society care for plants.

Proponents of biophilia argue that, rather than referring to a single behavior, biophilia encompasses a broad complex of responses to nature, which include affinities to landscapes and domestic and wild animals, as well as aversions to snakes and cliffs or other high places that pose a threat to humans (Soule 1993). Kellert (2005) further describes the wide range of values derived from human biophilic dependence (see Table 3.1) and argues that individuals may vary in the types and degree of biophilic responses they express.

Kellert's Typology of Values of Nature	
Aesthetic	Physical appeal of and attraction to nature
Dominionistic	Mastery and control of nature
Humanistic	Emotional attachment to nature
Moralistic	Moral and spiritual relation to nature
Naturalistic	Direct contact with and experience of nature
Negativistic	Fear of and aversion to nature
Scientific	Study and empirical observation of nature
Symbolic	Nature as a source of metaphorical and communicative thought
Utilitarian	Nature as a source of physical and material benefit

Table 3.1. A simplified adaptation of Kellert's typology of values in nature. Adapted from Gullone 2000 and Kellert 2005.

As briefly mentioned above, some of the presumed implications for biophilia of Wilson's (1975; 1984) broader sociobiological project have been the source of years of debate (Allen, Beckwith et al. 1975; Lewontin, Rose et al. 1984; Segerstråle 2000). These debates tend to be over concern about this perspective's implied determinism (Kitcher 1987), and discomfort with its potentially dogmatic tone, especially problematic in gender and racial contexts (Leibowitz 1985). One implication of these concerns is that those mired in urban poverty and cut off from nature may lead a less fulfilling existence, therefore the sociobiological thesis may be accused of cultural and class bias (Kellert and Wilson 1993). Sideris (2003) further notes two additional contradictions inherent in the notion of biophilia; first, that despite their affinity for nature humans readily kill animals[2], and second, that by proposing that humans have averse reactions to dangerous animals such as snakes, biophilia may inadvertently serve as a basis for destroying certain groups of animals rather than for conservation of all biodiversity as perhaps originally intended by Wilson (1984). Though such contentions regarding biophilia may be valid in terms of questioning the utility of biophilia in purely instrumental discussions regarding biodiversity conservation, they do not seem to be in conflict with this contribution's use of the concept to emphasize inherent biological attraction among and between other biological entities, and to emphasize ecological identities held by humans that reject extreme and counterproductive anthropocentric views, such as human exemptionalism and human exceptionalism.

Despite the furor caused by Wilson and what some deem as implied determinism in his sociobiological thesis (Kitcher 1987), notions of biophilia resurface regularly. Examples of works picking up on or elaborating upon the themes of Wilson's

[2] The author does not believe that killing animals must necessarily indicate less affinity for life or nature; see Tantillo, J. (2001). Sport Hunting, Eudaimonia, and Tragic Wisdom. *Philosophy in the Contemporary World*, Vol 8, No. 2.

biophilia hypothesis include Kellert and Wilson's (1993) edited volume *The Biophilia Hypothesis*, Lewis's (1996) *Green Nature/Human Nature*, and Kellert's (1997a) *Kinship to Mastery* and (1997b) *The Value of Life*, as well as his more design oriented books (2008) *Biophilic Design* and (2005) *Building for Life*. More recently the Meristem Forum released a book entitled *Restorative Commons: Creating Health and Well-being through Urban Landscapes* (Campbell and Wiesen 2009), which invokes the concept biophilia frequently in examples of humans restoring landscapes. Other books incorporating the notion of biophilia into design and planning continue to appear, such as Beatley's (2010) Biophilic Cities and Almusaed's (2010) *Biophilic and Bioclimatic Architecture*.

Perhaps most recognizably in the popular press, Richard Louv (2005) introduced the world to the term nature-deficit disorder among children, which refers to the alleged trend that children are spending less time outdoors, resulting in a wide range of behavioral problems. One could argue that nature-deficit disorder is what happens when biophilia is suppressed among people, especially children. When interviewed for the *Why Files*, an online science magazine, Louv gave credence to the linkage between biophilia and nature-deficit disorder by noting that biologist E. O. Wilson and his colleagues have long talked about the biophilia hypothesis and that even as people are migrating to cities around the world, "We are still hunter-gatherers biologically." Louv adds, "There is something in us that needs nature. When we don't get it, we don't do so well." [3] Whether one agrees or not with Louv and the others listed above, these various manifestations of biophilia since its original inception indicate that some segment of society resonates with claims made by Wilson and others that perhaps humans aren't as unique, aren't as special, as we have been led to believe, and that

[3]See http://whyfiles.org/shorties/211kid_nature/

there may be power in that simple realization and in efforts to revisit the assumptions of anthropocentrism.

More than two decades after Wilson proposed biophilia, cell biologists have begun to explore the "biological attraction principle" (Agnati, Baluska et al. 2009), which states that there is an inherent drive for association and merging of compatible elements at all levels of biological complexity (Wallin 1927; Sapp 1994; Baluška, Volkmann et al. 2004; Baluška, Volkmann et al. 2004; Margulis 2004; Rivera and Lake 2004; Agnati, Baluska et al. 2009; Agnati, Fuxe et al. 2009; Nicholson 2010; Shapiro 2011; Kozo-Polyansky (1924) 2010). Analogous with the gravitation law in physics, biological attraction posits that each living organism builds an attractive field around itself, and that this field acts as a sphere of influence that actively attracts similar fields of other biological systems, thereby modifying salient features of the interacting organisms. Echoing earlier ideas about biophilia, the biological attraction principle asserts that "the biological drive of attraction is inherent to living and evolving systems and is the result of their inherent biological activities" (ibid. p. 554). Further, because it is capable of active modification of some of the salient features of the environment (niche) in which they live, living systems are, therefore, acting on other living organisms, which are sensitive to these features. Importantly, Agnati and colleagues argue that sensitivity to this biological attraction seems to increase in biological systems *under stress* (emphasis added), such as, as I argue in this contribution, red zones.

The implications for this newer manifestation of biological attraction should be clear in hazard, disaster, and other contexts characterized by vulnerability and stress. The Biological Attraction principle as outlined by Agnati and colleagues appears to have

both explanatory and predictive utility. They argue that it can explain the evolutionary origin of eukaryotic cells, multicellular organisms, and complex ecosystems, and perhaps most salient to this paper's argument, can predict "…a further tightening of bonds in our society, especially when exposed to stress situations" (p. 554).

The work of Agnati and colleagues helps us hold on to the essence of Wilson's biophilia, that we are part of nature as demonstrated by our evolutionary traits, while perhaps allowing us to jettison the historical and political baggage that accompanies. A new biophilia, urgent biophilia, rises to provide an explanation for a preponderance of evidence that exists suggesting the restorative effects of seeing and doing green. Do we remember that we are not unique, exempt, or particularly exceptional in the geophysical scheme of things best after being "flattened" by circumstances beyond our control? What can we learn from this?

From biophilia to cultivating resilience?

Fredrickson et al. (2003) hypothesize that resilient people are buffered from depression by positive emotions and that resilient people thrive through emotions (see also Okvat and Zautra in press). In a study entitled "What Good are Positive Emotions in Crisis? A Prospective Study of Resilience and Emotions Following the Terrorist Attacks on the United States on September 11th, 2001," Fredrickson et al. (2003) conclude that: a) positive emotions do not disappear in times of acute and chronic stress but rather are present and functional during crisis, and b), that:

efforts to cultivate and nurture positive emotions in the aftermath of crisis pay off both in the short-term, by improving subjective experiences, undoing physiological arousal, and enhancing broad-minded coping, and in the long-term, by minimizing depression and building enduring resources, the hallmark of thriving (p. 374).

They further suggest that "finding positive meaning may be the most powerful leverage point for cultivating positive emotions during times of crisis" (Ibid.).

The use of the word cultivation in the passages above is appropriate at two levels, both explicit and metaphorical. The metaphoric level, and its nod towards urgent biophilia which I link to both the *creation of* and *benefit from* restorative environments, appears more clearly with further study of the word's many meanings. Cultivation has its roots in the transitive verb cultivate which is defined[4] as:

1. a. To improve and prepare (land), as by plowing or fertilizing, for raising crops; to till.
   b. To loosen or dig soil around (growing plants).
2. To grow or tend (a plant or crop).
3. To promote the growth of (a biological culture).
4. To nurture; foster.
5. To form and refine, as by education.
6. To seek the acquaintance or goodwill of; make friends with.

[4] http://education.yahoo.com/reference/dictionary/entry/cultivate;_ylt=Al3kDE0jJEFvFFovLHdfB2CsgMMF

Keeping in mind these definitions of cultivation, and recognizing their relationship to Kellert's typology above (Table 3.1), it is intriguing to contemplate aspects of cultivation within the literature on positive emotions and nature. In a study of positive emotions in residential environments in post-war settlements in Germany, Graff (2006) found a strong positive response to greenery, confirming yet again the work of Ulrich, Kaplan and others. Similarly, evolutionary psychologist Haviland-Jones and others (2005) have used language reminiscent of systems thinking's use of feedbacks and virtuous cycles (Weinstein and Tidball 2007; Tidball and Krasny 2011; Tidball and Weinstein 2011), which are often important features of resilient systems, to describe the relationship between humans cultivating plants and cultivating positive emotions:

(C)ultivated flowers fit into an emotional niche - their sensory properties elicit human positive emotions. The flowering plants are thereby rewarding to humans and in return, the cultivated flowers receive propagation that only humans can provide. Demonstration of such a phenomenon fills several gaps in the literature. It supports the basic significance of emotion for survival. As a corollary it supports the adaptive function of positive as well as negative emotion…and opens an area of investigation into the psychological relationships between humans and other species through their sensory properties that have been relatively neglected (p. 127).

Lohr and Pearson-Mims similarly (2006) report that people experience more positive emotions, such as friendliness and fewer negative emotions, such as sadness, when they are looking at urban scenes with trees than when looking at the same scenes containing inanimate objects (pp. 676-677).

Several other studies have pointed to the value individuals, as well as communities, place on trees and other aspects of nature immediately after a disaster, alluding to notions of cultivation's characteristics of nurturing and protection. An example can be found in Hull's work in which he identified urban forests as the most significant feature that was damaged by a hurricane, despite the fact that there was significant damage to buildings (Hull 1992). According to residents, of the numerous values associated with the urban forest post-Hugo, positive emotions evoked by trees were most important, followed by the importance of trees in defining Charleston as a community or place. According to Hull (1992), "the role of urban forests as symbols of cherished meanings and memories needs to be emphasized as a major benefit deriving from urban forestry…Trees symbolize spiritual values, personal memories, reminders of the past, preservation and endurance" (p. 3). This cultivation of trees as important symbolically as well as functionally is dealt with in greater depth in my work in post-Katrina New Orleans (see Tidball and Krasny 2008; Tidball 2009; and Ch. 4 this volume).

Links between urgent biophilia and resilience

This contribution has as one of its aims the examination of the linkages between urgent biophilia and resilience from individual, through family, neighborhood,

community, and larger spatial and temporal scales in hazard, disaster and vulnerability contexts. Urgent biophilia, or the idea that human-nature interactions and the positive emotions they elicit can rapidly and unexpectedly play an important role in conferring resilience across scales in post-disaster contexts, will undoubtedly be met with resistance, given such other equally urgent needs as personal safety and security, food, water, medical supplies, and re-building functional infrastructure. Despite this, and referring to resilience scholars Walker and colleagues (2002), understanding where resilience resides in the system, and when and how it can be lost or gained, is required to manage a system for resilience.

Here I hypothesize that one source of SES resilience after a disaster is humans' affinity for nature and the urge to express that affinity through creation of restorative environments, which may also restore ecological function. In other words, resilience in a red zone system may reside in places like memories of the value of interacting with plants (Tidball, Krasny et al. 2010) or other life forms, in the act of expressing urgent biophilia as argued here, or in the planted, restored spaces themselves. I suspect that resilience in red zone systems likely resides in a combination of all of these. As it relates to the adaptive cycle (Holling and Gunderson 2002) it would appear that the contribution of urgent biophilia to SES resilience resides or flourishes in the "back loop," the time of greatest potential for the initiation of change in the system (Walker and Salt 2006, p. 82; see also Figure 3.1). In this vein, I propose revisiting Folke et al.'s (2002) statement that "*erosion* of the sources of resilience leads to *fragile* social-ecological systems, with *consequences* for human livelihoods, vulnerability, security, and conflicts" (emphasis added, p. 51). Instead, tailoring the Folke et al. statement as a way of understanding urgent biophilia as a source of resilience, I posit that: *cultivation*

of the sources of resilience may lead to *vital* social-ecological systems, with *positive implications* for human livelihoods, vulnerability, security and conflicts. Greening in the red zone, then, can be imagined as a manifestation of a conscious, urgent biophilia acting as and activating a source of resilience in post-conflict and post-disaster settings.

Conclusion

In summary, integrating Wilson's (1984) notions of biophilia with more recent research on positive responses to plants and green spaces including in post-disaster settings, I have proposed the following explanation for an urgent biophilia. During more stable periods, humans exhibit varying degrees of affinity for nature at what Wilson and others argue is a mostly sub-conscious level. We often use forms of nature stewardship to recover from personal hardship. However, in post-disaster contexts, so-called human-nature interactions and the positive emotions they elicit may compellingly and suddenly come to the fore in heretofore unexpected ways, and be manifested in *immediate* and *conscious* actions, often beyond merely individuals to include neighborhoods, communities, and whole societies (see Figure 3.1). Urgent biophilia then is a highly sensitized manifestation of biological attraction where living organisms, including humans, build or utilize attractive fields around themselves, and that these fields act as spheres of influence that actively attract similar fields of other biological systems, thereby modifying salient features of the interacting organisms (Agnati, Baluska et al. 2009).

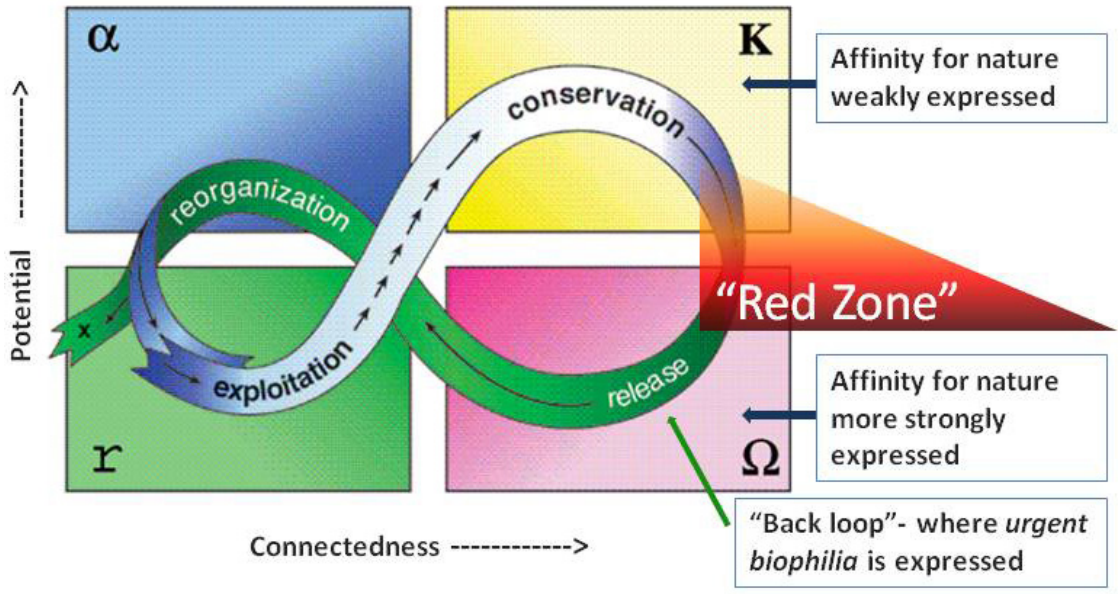

Figure 3.1. As adapted from Holling and Gunderson (2002), a stylized depiction of the four ecosystem functions (r, K, Ω, α) and the flow of events among them. Arrows show flow speed in the cycle; closely spaced arrows represent slow change and long arrows represent rapid change. The cycle reflects change in two properties (1) the Y axis is potential inherent in accumulated resources; (2) the X axis is the degree of connected among controlling variables. The transition from the K phase to the Ω phase is depicted here as "The Red Zone." Expression of biophilia is also represented, corresponding to the Y axis and potential. Low connectedness is associated with loosely connected elements whose behavior is dominated by external relations and variability. High connectedness is associated with elements whose behavior is dominated by internal relations that control or mediate external variability. The "back loop," in green, represents the stage during which *urgent biophilia* is likely expressed. The exit from the cycle at the left of the figure suggests the stage where the potential can leak away and where a "flip" into a less organized and desirable system is likely.

Further, such manifestations of affinity for nature after a disaster, *urgent biophilia*, may play a critical role in the ability of humans and larger social-ecological systems to recover post-disaster. This switch from base-line sub-conscious biophilia or biological attraction during times of growth and stability, to conscious urgent biophilia during times of collapse followed by reorganization reflects cyclic changes described as the adaptive cycle in SES resilience writings (cf.Gunderson and Holling 2002). Once war,

hurricanes, earthquakes, tsunamis, or another disaster threaten to “flip” a SES into a less desirable state, humans may respond to feeling threatened or a sense of loss by seeking physical and emotional affiliation with other living organisms, and in so doing, may aid themselves, as well as other parts of the system, in recovery. Should this urgent biophilic response also include individuals working collectively to enhance their local environment, e.g., through community forestry and community gardening, it may further contribute to recovery of other ecological elements of the larger SES. Although this urgent response does not necessarily take us in the direction that Wilson and others envisioned when proposing biophilia (i.e., furthering the claims of sociobiology or conservation of biodiversity), it may have implications for better understanding human-nature interactions in SES experiencing hazard, disaster, or vulnerability, and the relationship those human-nature interactions have to SES resilience.

Thus far the evidence for urgent biophilia as a possible explanation for the myriad examples of greening in hazard, disaster, and vulnerability contexts (Tidball and Krasny in press) comes from synthesizing on-the-ground examples with research about human-nature relations and social-ecological systems resilience. Because research that focuses specifically on greening responses in hazard, disaster, and vulnerability is hard to come by, this chapter is meant to stimulate thinking about possibilities—about the potential for greening to help people reorganize and rebuild after surprise or rapid change. Such thinking will inevitably raise questions that could be answered by inter-disciplinary research drawing from the social and ecological sciences.

For example, in the area of human-nature relations, much work has been done on the emotional, psychological and cognitive impacts of exposure to green spaces among hospital patients, young children, and residents of low income housing, and a few studies have been conducted on the outcomes of active engagement in greening among urban greening participants, yet we currently lack empirical research, such as long-term, comparative, or other studies, that more rigorously tests the impacts of greening specifically on individuals and communities in hazard, disaster, and vulnerability contexts.

Relative to social-ecological systems resilience, many studies have described social and ecological processes within particular systems, for example fishing dependent villages in Southeast Asia (Daw, Adger et al. 2009), First Nations communities in the boreal region of Canada (Berkes, Colding et al. 2000), and forest dependent communities in the Pacific Northwest (Fernandez-Gimenez, Ballard et al. 2008). Other authors have described rebuilding processes post-disaster (Vale and Campanella 2005) or have distilled characteristics of disasters, including frequency, magnitude, and extent, that can be used as a basis for planning interventions (Pelling 2007). However, to date there are few if any empirical studies that use a social-ecological systems framework to study processes occurring in disaster and conflict zones, and that treat these zones as a type of emergent and relatively short-lived, perhaps ephemeral social-ecological system with a unique set of characteristics different from those of other systems. Do disaster and conflict zone systems share commonalities relative to social and ecological processes that cut across specific contexts?

A fundamental issue for future research around these questions is how researchers might partner with on-the-ground implementers and policy makers in defining research questions, collecting data, and other aspects of the research process. When policy makers, project implementers, and community leaders working in hazard, disaster and vulnerability contexts are involved in research, questions may be better informed by real-life experience and needs, and the results may be more readily reinserted into policies and on-the-ground practices.

Many difficulties face a researcher investigating urgent biophilia and the role of greening in hazard, disaster, and vulnerability contexts. Given the dangerous and challenging conditions that characterize these contexts and the oft-times spontaneous responses, controlled experiments will likely be impossible. Instead "natural" experiments looking at variations in conditions that occur in the field, or qualitative research that follows urgent biophilia and resulting greening practices in-depth and over time, may be employed. In addition, commonly held notions about linear relationships may not hold. For example, the ability of a community to mount a greening or other response to disaster depends in part on *existing* human capital, yet at the same time when a community is able to take charge and respond effectively to a disaster, human capital may be *created*. The same may be true for social, cultural, and natural capital, as well as for sense of place. Further complicating any research endeavor, these different capitals interact with each other through greening, as when a group of individuals with trusting relationships and a history of volunteerism (aspects of social capital) is able to come together to recreate natural capital lost in a disaster

(e.g., by planting trees). These relationships may be envisioned as the different forms of capital nested within each other in a progressively larger series of concentric rings (from human to social to ecological, cf. Wimberley 2009). Alternatively, processes at the individual, social-cultural, and ecological scale may be viewed as nested adaptive cycles forming panarchies of small-scale, relatively fast processes both impacting and being impacted by larger and slower processes (cf. Gunderson and Holling 2002). To add to the research challenges, multiple forms of capital that are integrated in a greening response serve as both sources and expressions of resilience during disaster as well as during the rebuilding period.

Despite these challenges to researching in greater depth urgent biophilia and greening, the fact remains that an understanding of the importance of human-nature interactions at the point when social-ecological systems are experiencing upheaval and the humans within them experiencing great vulnerability is of critical importance (Vining, Merrick et al. 2008). Such an understanding of human-nature interaction in terms of resilience can only help when disaster or war strikes, and it is my hope that future research into urgent biophilia as it is manifested in greening in hazard, disaster, or vulnerability contexts will contribute to efforts by governments, NGOs, and others to adapt, reorganize, and rebuild in the aftermath of crisis.

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CHAPTER 4

PAPER III- TREES AND REBIRTH: SOCIAL-ECOLOGICAL SYMBOLS, RITUALS AND RESILIENCE IN POST-KATRINA NEW ORLEANS

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The morning after the storm, hundreds of live oaks still stood among the rubble along the coast. They held in their branches a car, a boat, pages torn from books, furniture. Some people who managed to climb out of the windows had clung to the oaks for survival as the waters rose. These ancient trees, some as many as five hundred years old, remain as monuments not only to the storm but to something beyond Katrina as well – sentries, standing guard, they witness the history of the coast. Stripped of leaves, haggard, twisted, and leaning, the trees suggest a narrative of survival and resilience. In the years after the storm, as the leaves have begun to return, the trees seem a monument to the very idea of recovery.

Natasha Trethewey, Poet and Author

From her book (2010) *Beyond Katrina-A Meditation on the Mississippi Gulf Coast.*

Introduction and background

Hurricane Katrina made landfall in New Orleans, Louisiana, USA on August 29th, 2005. The story of New Orleans' struggle to endure weeks of inundation and devastation, and months of disorganized efforts to recover from the disaster, is well-known (United States 2006; Waugh 2006; Brunsma, Overfelt et al. 2007). However, the important symbolic roles of trees and the act of tree planting in post-Katrina New Orleans as part of the disaster and recovery discourse are less well-known.

Returning residents related to me many stories about the New Orleans landscape before Hurricane Katrina, the role that trees played in their lives, how after the storm they used trees as landmarks to find the place where their home once stood, and how the surviving trees gave them hope that they too would persist, would persevere, and would maintain their roots in New Orleans. This relationship between humans and trees, their symbolic meanings as objects and the meanings associated with their planting and care in the wake of a disaster, and the implications of these symbols and interactions for the resilience of perturbed social-ecological systems (SES) is the subject of this chapter. Central is the argument put forward by Berkes and Folke (1998) that systems that demonstrate resilience appear to have learned to recognize feedback, and therefore possess "*mechanisms* by which information from the environment can be received, processed, and interpreted" (p. 21, emphasis added). In this sense, these scholars go further than simply recognizing that people are part of

ecological systems by attempting to explore the means, or social mechanisms, that bring about the conditions needed for adaptation in the face of a disturbance and therefore resilience. One such resilience-conferring social mechanism extensively documented by Berkes and colleagues is traditional ecological knowledge (Berkes, Colding et al. 2000; Davidson-Hunt and Berkes 2003; Berkes 2004; Berkes and Turner 2006). Perhaps, as I submit herein, there are other resilience-conferring social mechanisms, such as social-ecological rituals and symbols.

In this chapter, following from earlier work on "memorialization mechanisms in disaster resilience" (Tidball, Krasny et al. 2010), I posit that tree symbols and rituals, and how tree symbols and rituals are remembered, re-constituted, and reproduced, represent a cluster of social mechanisms that can be viewed as "tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience" (Berkes and Folke 1998, pp. 21-22). I continue to draw upon Berkes and Folke's (2002) argument that some SES build resilience through the experience of disturbance, but for this to occur, sufficient memory from both ecological and social sources for reorganization must be present. Thus, I argue, the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components, feedbacks and cycles catalyzed by these relationships, all contribute to system memory, processes involved in "regeneration and renewal that connect that system's present to its past"(Gunderson, Pritchard et al. 2002, p. 264) and aid in conferring resilience.

Shortly after the floods subsided in New Orleans, community organizers in the city reached out to universities with planning and other related expertise (Foley, DeFries et al. 2005), including Cornell University's Department of City and Regional Planning, which created the New Orleans Planning Initiative (NOPI). The Cornell NOPI team, of which I was a member, looked at environmental and open space issues in New Orleans' 9th Ward using highly-participatory forms of resident-led assessment, planning, design, and development (Reardon, Green et al. 2009). In this chapter I rely on the above experiences and subsequent observations to attempt initial integration of theories of symbol, ritual, ecological anthropology, and SES resilience, following from Van Gannep (1960), Turner (1967), Rappaport (1984), and Berkes and Folke (1998). In so doing I posit that the social-ecological symbol of the tree, the ritual of tree planting as a form of recovery, and the resulting feedbacks and virtuous cycles (see chapter 6, this volume) contributed to SES resilience at multiple scales in post-Katrina New Orleans.

I explore this position in three steps. First, I provide brief and general reviews of the extensive research on the individual and community aspects of exposure to and interaction with trees and other plants as a foundation for this exploration. Second, I present a selective discussion of theories about symbols and rituals, especially related to trees. Third, with these literature reviews and theoretical concepts in hand, I provide elaboration from my New Orleans field study of the use of trees and tree planting as symbolic and ritual sources and demonstrations of resilience in perturbed SES.

Finally, I conclude with a discussion of the importance of tree symbols and rituals in post-catastrophe resilience, with potential implications for other red zones.

Context and literature review

This inquiry is informed by the anthropological work of Roy Rappaport (1984), who applied a cybernetics or environmental feedback system to the ritual regulation of the Tsembaga people of New Guinea (McGee and Warms 2004, p. 297). In his seminal work, Rappaport applies the ecological concepts of "regulatory mechanism" and "negative feedback" to analyze cyclical behavior among the Tsembaga, and other Maring-speaking peoples of New Guinea (Rappaport 1984). In this work, Rappaport launches the integration of anthropological and ecological analysis, and reframes ritual as an ecosystem regulatory mechanism (Brown 2008), a foundation I attempt to expand upon in the following pages.

The tree is said to be one of humankind's most potent symbols (Fontana 2003, p. 167). According to Davies (1989), the tree presents itself as a medium of thought through its possession of trunk, roots, and branches, and because it serves as a habitat for other creatures. Further, Davies argued that a tree may stand as "a living entity spanning many generations and therefore avails itself as a historical marker and social focus of events" (Ibid). The life of a tree lasting longer than human generations may provide an analogical resemblance between long lived trees and big families, and the life of a tree spanning from one generation to another facilitates trees being identified with the

concept of “stability/immortality” (Daniels 1989). It is therefore easy to imagine how a tree could symbolize both loss and rebirth.

Frazer, in his seminal work *The Golden Bough* (1915), was among the first to devote significant effort to understanding the symbolic use of trees by humans, though his understanding was later called in to question by other anthropologists (cf. Wittgenstein 2002). Other important figures in the field of anthropology, such as Victor Turner (1967), have also explored trees in symbol and ritual, because “…trees are used symbolically to make concrete and material the abstract notion of life [and are] … ideal supports for such symbolic purpose precisely because their status as living organisms is ambiguous” (Rival 1998, p. 3).

Trees as symbols are employed in multiple ways: to depict life cycle rituals, to make sense of the human body, to visualize kinship, and to express solidarity, continuity and vitality of a community, among others (Rival 1998). Trees as symbols often stand in opposition to the symbols of death and decay. It is this last expression I am focusing on here, how the symbolic elements of tree presence and tree planting contribute to the solidarity, continuity, vitality, and I would add, resilience, of a community and the social-ecological system within which it resides.

From my own work in New Orleans, I recorded a community member involved in the Tree Trooper course offered by New Orleans greening organization Parkway Partners after the storm, speaking about the importance of being involved in planting trees after

Katrina. This person said that trees represent "…a symbol of our recovery – of re-birth. Every time I pass a place where trees have been replanted it gives me hope." Another Tree Trooper, who later formed a successful planting operation in New Orleans, said, regarding trees and tree planting:

…to plant trees is to give body and life to one's dreams of a better world. I like that [statement] a lot. What I realized…doing this is that you don't plant trees where there's no hope for a better future… if there's no hope for a future you're not going to put a tree there. What would be the point? …so if we're not going to be around to see it, then why, why would we plant it?

Whereas these and many other statements from survivors provide testimony of the critical symbolic role of trees in the weeks and months immediately following disaster, research-based evidence for the role of trees in helping people and communities recover from disaster is limited. In a study of residents affected by Hurricane Hugo, 30% of survey respondents identified trees as the most significant feature that was damaged by the hurricane, and cited positive emotions evoked by the urban forest, followed by the importance of trees in defining Charleston as a community or "place," as being particularly important. Hull (1992) concluded that the role of urban forests as symbols of cherished meanings and memories needs to be emphasized as a major benefit deriving from urban forestry. However, research studies that focus specifically on the role of trees and tree planting and care in post-disaster recovery appear to be lacking.

Despite the paucity of studies specifically on the role of trees and tree planting in post-crisis ritual, symbol, or resilience, there is a considerable literature documenting

people's opinions and attitudes regarding the meanings and values of trees generally (Gorman 2004). Studies have focused on attitudes toward specific species of trees (Sommer, H. Guenther et al. 1990; Schroeder and Ruffolo 1996; Anderson 2004), and residents' attitudes and behavior regarding tree planting and care (Summit and McPherson 1998). Based on the results of research in Chicago IL, Dwyer et al (1991) argued for an approach to urban forestry that "takes into consideration the deep psychological ties between people and urban trees and forests." Similarly, Appleyard (1980) characterized trees as "anchors of stability in the urban scene." Perceived economic benefits (Daily 1997), social benefits (Coley, F.E. Kuo et al. 1997; Westphal 2003), symbolic importance (Smardon 1988), and psychological value (Ulrich 1984; Hull 1992; Perlman 1994) of trees and other greenery also have been documented.

The research-based evidence for the role of trees and other greenery or plants in human and community well-being is particularly well-documented. On an individual level, gardening or the ability to see or experience green space is reported to help people recover from grief (Relf 1998), deal with the trauma of war (Helphand 2006), reduce domestic violence (Sullivan and Kuo 1996), quicken healing times and reduce stress (Ulrich 1984), improve physical health (Ulrich 1984; Tennessen and Cimprich 1995), reduce poor birth outcomes (Donovan, Michael et al. 2011), and bring about cognitive and psychological benefits for children and adults (Kaplan 1973; Kaplan and Kaplan 1989; Faber Taylor, Wiley et al. 1998; Wells 2000; Faber Taylor, Kuo et al. 2001). These individual benefits may result in positive impacts on organizations and communities including increased worker productivity (Kaplan 1993), potentially

increased consumer traffic and thus purchases in business districts (Wolf 2003), increased property values resulting in greater municipal revenues (Wachter 2004), and creating a sense of connectedness to the community and thus reducing crime (Kuo, Bacaicoa et al. 1998).

Dwyer et al (1991) distinguished between the meanings or impacts of trees *per se* and the act of tree planting in their study of urban residents in Chicago. According to Dwyer et al (1991), "commitment to tree planting suggests that it has benefits in and of itself that go beyond the expected benefits of the resulting trees." Possible explanations for this strong commitment to tree planting include: (1) the value of tree planting as a demonstration of commitment to the future, (2) the act of tree planting as a significant impact on the landscape over time, and (3) tree planting as a means of improving the environment (Dwyer et al 1991). Similarly, Miles et al (1998) examined the individual level impacts of engagement with nature through participation in volunteer natural area restoration efforts in Chicago, and found that those volunteers who were more active experienced greater satisfaction. According to Miles et al (1998), "restoration is a form of involvement with nature that combines the benefits usually associated with nature activities with the benefits associated with volunteer conservation and leisure activities" (p. 59). Lohr and Pearson-Mims conclude their study of urban tree preference with the boldly unequivocal statement "Human well-being can be improved by planting trees of any form" (2006, p. 685).

Lest there appear to be naiveté in this argument, a caveat here is appropriate. There are examples of symbols such as trees and forests and their planting or removal being used for less than benevolent purposes, or contributing to red zones rather than ameliorating them (Guha 1989; Fairhead and Leach 1996; Scott 1998; Cronon 2003; Prudham 2004). For the purposes of this book on greening activities in red zones, perhaps a most salient example exists in the Israel /Palestine territorial conflict. Here, according to Braverman (2009) there are two dominant and highly symbolic tree landscapes; pine forests and olive groves. The pine tree is associated with Zionist afforestation of the Promised Land, while the olive tree symbolizes the long agricultural connection to the land held by Palestinians (Ibid.). In his book Braverman describes in great depth the story of trees through the narratives of military and government officials, architects, lawyers, Palestinian and Israeli farmers, and Jewish settlers, including cases of trees actually being targeted by military forces, removed, and destroyed, in some cases repeatedly. He says succinctly:

> …*in this pitting of the pine tree and its people against the olive tree and its people, a discursive and material split is constructed with dogged determination by the two national ideologies that compete in and over the landscape of Israel/Palestine, so that these two tree types assume the totemic quality of their people, reflecting and reifying the standing conflict* (p. 165).

In this conflict the tree's role as an "ultimate connotator of land" is indisputable, because "anything connected to land in Israel/Palestine is also strongly aligned with national affiliations" (p. 218); in such a case it is not surprising that trees hold such tremendous national symbolic power. Similarly Perlman (1994) concludes:

> *… the connection between trees and the military imagination needn't always lead to an embrace of literal militarism and national chauvinism …yet the presence of trees…can be involved with and invoked by reactionary nationalistic and political movements and lend vitality to authoritarianism and mass violence* (p. 108).

The above caveats notwithstanding, the testimony of disaster survivors reported by the media, and studies on the symbolic power, health, and community value of trees and other greenery, together provide strong support for a hypothesis regarding the importance of trees and tree planting in societal, and ecological, responses and recovery from disaster. Recalling the recognition by the Resilience Alliance (2010) that "resilience in social systems has the added capacity of humans to anticipate and plan for the future," it is important to keep in mind that though people do not have the ability to decide what is destroyed by a disaster, they do have the ability to decide what is reconstructed (Miller and Rivera 2007). Therefore, that which is reconstructed, like green spaces or an urban forest, symbolizes the cultural, social, political, and ecological ideals that the society values and wants to transmit (Foote 1997; Baker 2003; Tidball, Krasny et al. 2010). I invite the reader to continue on in this exploration of how trees and tree planting reflect and communicate the aforementioned ideals.

On symbols, rituals, and trees: theoretical considerations

The origins of studies of symbols and rituals are found for the most part in the field of anthropology. Since its inception, the field of anthropology has concerned itself "as much with the ways in which natural processes are conceptualized and the natural

world classified, as with the ways in which human societies interact with their natural environments and use natural resources" (Rival 1998). The relationship between natural environments that feature trees and rituals and symbols is well described in anthropology, from classics like Victor Turner's milk tree in *The Forest of Symbols* (1967) to more recent explorations by Rival, Brosse, and others in *The Social Life of Trees* (1998). Trees as symbols often appear in life cycle rituals or are used as kinship models, and are frequently seen deployed as images of continuity and reproduction as contrasted to images of change and destruction (Ibid.). Trees can also be used to symbolize other values within the built environment (Egenter 1981; Nute 2004). For example, current research in fields of horticultural therapy, natural resources management, city and regional planning, and SES resilience acknowledge both biophysical and cultural aspects (such as ritual, symbol, sense of place, etc.) to trees in urban contexts.

Renowned social scientist and founder of American anthropology Franz Boaz (1935) characterized the symbolic use of trees in Kwakiutl mythology succinctly with his observation that "the trees appear personified" (p. 169). But as Perlman (1994) points out, applying Boaz's observation to tree symbolism more broadly does not necessarily imply literal animism. Instead, as Perlman indicates, we can think in James Hillman's (1975) terms, in that speaking of trees as persons is part of giving a place to the psyche's propensity to personify as a way of defining what or whom is felt as valuable, powerful – "as a necessary mode of understanding the world and of being in it" (p. 13).

New Orleans is said to be home to some of the largest collections of mature trees in the world, containing nearly 50 species, including magnolia, pine, live oak, bald cypress (Louisiana's official state tree), and red maple (Goudarzi 2006). Historically trees have held special symbolic significance to residents of New Orleans, contributing to identity and sense of place (Anderson 2004; Nell Greenfield Boyce 2005; Kearns 2006; Chamlee-Wright and Storr 2009). City Park in New Orleans boasts the largest collection of Live Oak trees (*Quercus virginiana*) in the world[5], 249 of which are registered with The Live Oak Society , an organization founded in 1934 to promote the "culture, distribution, preservation and appreciation of the Live Oak tree." The Live Oak Society epitomizes the importance of trees to New Orleans, and perhaps to cities more generally. The Live Oak Society[6] began with 43 member trees and as of 2011, boasts 6698 members in 14 states. There is only one human member of the society at a time according to the by-laws of the Society. That person is the chairman, who is responsible for registering and recording the Live Oak Society member trees. The special significance and appreciation of trees in New Orleans is perhaps best described by the residents themselves. One of whom I interviewed said:

I live two blocks from Napoleon and three from St. Charles, and the trees are a major reason I first fell in love with New Orleans.

I now begin a turn toward exploration of observations of how, in the wake of Hurricane Katrina, trees as symbols have been observed to take on additional and

[5] http://neworleanscitypark.com/live_oaks.html
[6] http://www.louisianagardenclubs.org/los.html

more explicit meanings related to determination to recover from the disaster and demonstrate community resilience in New Orleans. Further, I describe observation of a kind of ritualization of the act of planting trees, which may result in deepening individual and community commitment to demonstrating and enhancing New Orleans's resilience. But first, some concepts.

Symbols

In a previous study of ritual and symbol in rural Appalachia involving other flora and fauna, my colleague and I describe how the study of symbols and symbolism is both interesting and problematic because a symbol is, by definition, something which stands for something else (Tidball and Toumey 2003; Tidball and Toumey 2007). The following few paragraphs borrow heavily from this earlier work to equip the reader with a general background in symbols and ritual as they relate to trees and tree-planting in red zone contexts.

The field of study dealing with rituals and symbols asks many questions, but the two most prominent remain: (1) what does a particular symbol stand for, that is, what is the idea or the thing behind the symbol?; and (2) how does a symbol represent something else? Raymond Firth describes the systematic and empirical features of twentieth-century anthropological studies (1973, p. 92-106) in his historical account of theories concerning symbols and symbolism. Two characteristics are especially important. The first is that the study of symbols is usually centered on ritual, defined here as patterned (or routine) collective symbolic behavior. With this understanding, one can observe

and describe the repetitive and predictable aspects of a ritual, and avoid dealing with isolated or idiosyncratic symbols. Given that a ritual is an instance of collective behavior, one expects some common understanding among participants of what the various symbols are supposed to represent. By treating a symbol as a phenomenon that occurs repeatedly and systemically in a regular pattern, and by deriving the abstract signified from the interpretations of multiple participants, the ritual-centered approach gives a good empirical grounding to the study of symbols and symbolism.

The second important characteristic is that anthropological approaches to understanding symbols rely on Ferdinand de Saussure's linguistic theories from his book, *Course in General Linguistics* (1966). Saussure taught that a symbolic relationship includes “signifieds,” that is, ideas that are best expressed by devices such as words, and “signifiers,” which are the devices used to represent an idea. Ideally, the signifier constitutes a clear, direct, and faithful representation of the signified, in which case the two together are called a sign. More commonly, however, sensory signifiers—words, emblems, images, slogans, objects, and so forth—cannot entirely represent abstract thoughts, if only because the sensory can never be equivalent to the abstract.

From symbols to social-ecological symbols and rituals

Going deeper into theories of ritual and symbols related to trees requires an understanding of ritual and symbolic analysis. I will limit discussion on ritual and symbolic analysis predominantly to that of the approach developed by Victor Turner.

Turner's (1967:19) oft-cited definition of ritual is a "prescribed formal behavior for occasions not given over to technological routine, having reference to beliefs in mystical beings and powers." Elsewhere he elaborates that a symbol is "the smallest unit of ritual which still retains the specific properties of ritual behavior" (Deflem 1991) or a "storage unit" filled with a vast amount of information (Turner and International African Institute 1968:1-2). Symbols can be located in objects, activities, words, relationships, events, gestures, or spatial units (Turner 1967:19). So then, rituals can be understood as storehouses of meaningful symbols by which information is revealed and regarded as authoritative, as dealing with the crucial values of the community (Turner and International African Institute 1968:2; Deflem 1991). But symbols reveal more than crucial social and religious values. They are also transformative for human attitudes and behavior, and therefore the handling of symbols in ritual exposes the power of symbols to act upon and change the persons involved in ritual performance (Deflem 1991).

Here I put forward a special category of symbols, social-ecological symbols, which are related to the concept "nested ecologies" (Wimberley 2009) and are a natural outgrowth of social-ecological systems, the concept of integrated "humans-in-nature" systems (Berkes and Folke 1998). Environmental or ecological symbols (Appleyard 1979; Kroll-Smith and Couch 1993), a subset of symbols generally speaking, use biophysical elements in nature to represent an idea. For example, a tree may represent rootedness. I define a social-ecological symbol as a symbol or "storage unit" containing both social and ecological meanings, and also, more importantly, social and

ecological interactions. Tree planting events or activities are social-ecological symbols. There is an ecological entity, trees, and a social activity, planting trees, which together communicate an idea. Social-ecological symbols, such as communities planting trees after their city is destroyed by a hurricane, can then, in the aggregate, be thought of as social-ecological rituals, storehouses of meaningful social-ecological symbols by which interrelated social and ecological information is revealed and regarded as authoritative, and is thought of as dealing with the crucial values of the community. These social-ecological symbols and social-ecological rituals can then be seen as sources of resilience and catalytic in the aforementioned resilient systems that appear to have learned to recognize feedback, and therefore show promise to act as "*mechanisms* by which information from the environment can be received, processed, and interpreted" (Berkes and Folke 1998, p. 21, emphasis added).

In contrast to many anthropological symbol and ritual studies that focus on a geographically bound or an ethnically homogenous indigenous groups, or a specific neighborhood, in New Orleans I have come to understand the participants or actors in my study of post-Katrina reforestation as members of a distributed community of practice (Lave and Wenger 1991; Wenger 1998a; Smith 2003, 2009) which embodies most predominately symbols and ritual around the act of planting and caring for trees. Tree symbols and tree planting rituals spanned geographically dispersed neighborhoods and included multiple ethnic groups.

Communities of practice can be thought of as self-organizing systems (Wenger 1998b) and are thought to embody many of the benefits and characteristics of associational life such as the generation of what Robert Putnam and others have discussed as social capital (Putnam 2000; Smith 2003, 2009). Importantly, a community of practice is characterized by mutual engagement in a joint enterprise (in this case tree planting) and a shared repertoire (Lave and Wenger 1991; Wenger 1998a). A distributed community of practice refers to a group of geographically distributed individuals who are informally bound together by shared expertise and shared interests or work (Daniel, Schwier et al. 2003). Although I leave a detailed description of the New Orleans reforestation distributed community of practice to a different conversation (Tidball and Krasny, in preparation), the point here is that NOLA residents organized around a particular area of knowledge and activity (trees and tree planting) and developed or reconstituted rituals and symbols that at once reinforced and reinvented the accumulated knowledge of the community. This suite of practices contributed to enhancing a sense of joint enterprise (tree planting) and identity around planting trees as a means of recovery; as consistent with Wenger's descriptions of communities of practice.

Ethnographic, interview and content analysis methods

I move now into the field study in which I apply the earlier literature review and theory refinement regarding ritual and symbol and trees and tree planting. A complete treatment of methods used for this dissertation can be found in Appendix 1 of this dissertation. Triangulation of multiple methods were employed (Denzin 1970;

Hammersley and Atkinson 1983; Burgess 1984) to understand how tree symbols and tree rituals represent a cluster of social mechanisms that deal with disturbance and influence system resilience. Preliminary understanding of the post-Katrina New Orleans situation was developed using traditional ethnographic methods via my involvement in initial response and recovery efforts immediately after Katrina (Tidball and Krasny 2008). I used photography and videography to document tree symbols and tree rituals I encountered for later interpretation, and collected and interpreted other images, memorials, art installations, and other artifacts related to tree symbols and rituals. At the same time, public documents were reviewed including after action reports and briefings, plans and proposals for rebuilding in NOLA, press releases and news media coverage. Through this initial work, I was introduced to the leaders of four prominent organizational "players" in reforestation efforts in New Orleans after Katrina; the Louisiana State Forester in New Orleans, and the directors of Parkway Partners[7], Hike for KaTREEna[8], and RePlant New Orleans (now defunct). These persons were interviewed in depth over a period of months and years, and fulfilled the role of "key informants"[9] in this work.

I conducted participatory rapid assessments of green infrastructure immediately after the storm, and in 2009 enrolled in and completed the citizen forestry training program that was initiated after Katrina by Parkway Partners called "Tree Troopers." Tree Troopers are trained by the Parkway Partners "Releaf New Orleans" program to act as

[7] http://www.parkwaypartnersnola.org/ReLeafNewOrleansInitiative.html
[8] http://www.hikeforkatreena.com/
[9] Key informants, as the term is used in anthropology, are individuals selected on the basis of criteria such as knowledge, compatibility, age, experience, or reputation who provide information about their culture.

stewards of newly planted trees and existing trees. I participated in multiple tree planting events from 2006-2011. This participation with New Orleans residents in their reforestation activities represented predominantly applied ethnographic research, focusing on rapid assessment, relying heavily on visual anthropological methods and incorporating participant observation.

During the initial period of exploratory interviewing and item generation (Weller 1998), I conducted 30 short (5-10 minute) interviews of New Orleans residents affected by the storm, selected through convenience sampling within neighborhoods varying in the tree canopy, tree replanting, and demographic factors. These interviews contributed to helping me gain a better grasp of factors important to New Orleans residents and of terminology they use to describe their experiences. I transcribed and coded these data using ATLAS.ti software. Codes were inductively generated from the transcripts as opposed to fitting data into predetermined categories. Next I constructed matrices from the data to identify patterns and paradoxes, and to be able to readily compare these data with data from other aspects of the study (Maxwell 2006). Through analyzing the data independently of other phases of the research, I was able to arrive at commonalities and themes in post-Katrina trees and recovery discourses; in this way these data "complement" and "expand" on other phases of this study (Greene, Caracelli et al. 1989; Tashakkori and Teddlie 2003).

During the second phase of data collection, informed by Weller's (1998) narratives and individual accounts, I conducted expanded, in-depth, unstructured and exhaustive

interviews of individuals who referenced trees as part of their recovery during the 30 short exploratory interviews. I recorded and transcribed the interviews, and analyzed and coded the data as described above.

In addition to collecting the narratives, I provided some interviewees with a camera and asked them to "photo-essay" their response to the question: "How do trees matter to me after Katrina?" The interviewees and I then discussed and coded the photographs for emergent themes. This qualitative and participatory research method, known variously as participatory photography, photo-elicitation, photo-voice or photo-essay (Collier and Collier 1986 [1967]; Wang and Burris 1994; Wang, Burris et al. 1996; Wang 1999; Singhal and Devi 2003), was used to suggest possible interconnections and relationships across themes derived from the interviews, and to seek elaboration, illustration, and clarification of the results of interviews and participant observation. The photo-essay elaboration provided in this chapter is minimal and intended only to augment the qualitative interview data (but see Tidball & Stedman, in preparation, for a focused study on trees and post-Katrina recovery using exclusively photo-essay methods).

The interviews conducted over a 6 year period after Hurricane Katrina, as well as photo voice and other visual analysis, were conducted with multiple annual classes or cohorts of volunteer community foresters (the above-mentioned Tree Troopers annual training class), as well as community members at large. These individuals reflected a spectrum of social class, ethnic backgrounds, and age groups.

Findings

In describing some of the findings of this research, I will first ground the research in ethnographic terms, drawing upon other scholars of tree symbolism and my own observations. Next, I will delineate the various tree symbols encountered in post-Katrina New Orleans specifically, and present elaboration of these tree symbols and their meanings as described by residents. This elaboration includes descriptions of tree symbols with both positive and negative connotations, and is amplified by the photo-essays. I will conclude the findings section of this chapter with a description of the act of tree planting, by individuals and collectively, as symbol and ritual.

Discovering tree symbols in Post-Katrina New Orleans

Numerous examples hint at the importance of trees as symbols throughout the Gulf Coast area stricken by hurricane Katrina. In one case, I was told a story that over a hundred years ago a member of a Bay St. Louis family kept a Live Oak tree from being cut when a local road was being built. During Hurricane Katrina, three residents found their way to the oak and hung onto it for more than three hours, until they were rescued. The tree died after the storm and the three survivors asked a sculptor to carve the trunk into a pair of guardian angels that watched over them[10]. This interesting piece of ethnographic data collected while conducting participant observation is but one example of many trees that have been carved by sculptors, their trunks and main

[10] http://thanks-katrina.blogspot.com/2009/03/update-on-highway-90-sculptures.html

branches still protruding into the air from the coastal soil, but taking on new meanings, layered over old. At least 50 such tree sculptures exist along Interstate 90.

Ethnographic data collection yielded another example of the idea of the trees being used to communicate about Katrina through their symbolic power in the form of an introduction to the art installation at the Convention Center called "Scrap House."[11] The installation is a tree with a house in its branches, constructed from debris left by Katrina. The tree trunk and branches are made from cut-up 55 gallon drums. The artist, speaking about her work, mentions how impressed she was after the hurricane by images of strange assemblages like boats in trees, so she visualized a house blown or washed on to a tree top. The viewer cannot help but contemplate the tree form itself, holding up the house, the home, sheltering a fragile nest. It is also hard not to see in the tree's form human qualities of arms stretched to heaven, pleading, perhaps from a kneeling position. Of all the many forms and possibilities for a sculpture at perhaps the most visited space in New Orleans aside from Bourbon Street, this particular one leaves the viewer with a strong appreciation for the connection between massive trees and home, of the juxtaposition of the "natural" and built environment, in New Orleans.

[11] http://www.artscouncilofneworleans.org/article.php?story=20081116200403930

Figure 4.1. "Scrap House" installation in downtown New Orleans illustrates central symbolic importance of trees in post-Katrina recovery and remembrance. Photo: Jean Fahr, Parkway Partners.

The reality of strange assemblages and trees is familiar to many lower 9th Ward residents. I sat on a rocking chair on the porch of a woman I interviewed, who was one of the first Lower 9th Ward residents to return, looking down the miraculously still tree-lined Tennessee Street. Two years after the storm, I sat in a surreal moment, recalling how impassable this street was directly after the storm, how the houses were scattered amongst the trees, floated away from their steps and moorings, seemingly unaware of the grid and streetscape that was intended to contain and order them. The woman began to speak of the trees, gesturing towards them:

Yeah, they withstood, they withstood the storm…Well those trees are survivors of Katrina because the majority of my things was hooked up in that tree over there, I have pictures to show. When everything broke up, those trees survived Katrina… a lot of them were knocked down, but the farther you go, they were there, you know. Because the way the water went, the force of the water, it went like this (gesturing a flattening motion). Because them [sic] two big houses where the boards was went around it, and well… knocked most things down… Tennessee Street was like a clean slate… Those trees that, say, had about 15' of water, those trees survived, and those

down there, some people when the water came, that's what helped them out. They got in the trees where they [rescuers] picked them up, from the trees.

After this interview, I drove down Tennessee Street, where, a few blocks away, I saw a Live Oak with a sign attached to it, and a pretty blue ribbon. The sign had the address handwritten upon it, and at the same time labeled the tree what it once was, the "tree in front." The sign also indicated the property boundaries with the words "My marks… tree in back and tree in front." The tree conveyed a message, and served as a marker of occupation, of having been the site of a place called "home." There was certainly a tragic overtone in the tree sign, but also one of optimism. The site hadn't been abandoned, and the tree was still alive to convey a message, a claim on the land, as a gift with a pretty bow.

Figure 4.2. A surviving tree in the devastated Lower 9th Ward neighborhood of New Orleans, one of many used as symbols and markers of home. Photo by Keith G. Tidball, originally appearing in *Environmental Education Research* Vol. 16, Issue 5-6, 2010, and used with permission.

I found many other tree symbols at work in the years after Katrina, evoking roots and rootedness imagery, growth, cycles, and change (Tidball 2009). Supporting evidence

for these interpretations is found in the following pages. All of these images gave rise to the notion that tree symbols and rituals were important to recovery in New Orleans after Hurricane Katrina.

Memories of trees were also reported as important symbolically in the wake of Katrina. Similar to the learning through memory experiences of the indigenous communities observed by Berkes et al. (2000), some New Orleans neighborhoods described the importance of their post-Katrina tree planting in terms of recollections of errors in natural resource management from previous generations and the community's desires to learn from those mistakes (Tidball, Krasny et al. 2010). This was especially apparent in the neighborhood called Tremé, originating in the early nineteenth century.

Claiborne Avenue bisects the Tremé neighborhood and historically boasted a wide "neutral ground" lined with old and stately live oak trees. The public green space is said to have been used as a community gathering place for the area's mostly African-American residents. The construction of an elevated highway through the Tremé neighborhood above the oldest section of Claiborne Avenue in the late 1960s is thought to be one of the most controversial developments in the history of New Orleans. After construction, poorly lit asphalt parking lots under the freeway replaced the green neutral grounds, and concrete supports for the highway replaced stately oak trees. Construction of the overpass contributed to the overall decline of the Tremé neighborhood in the 60's and 70's (Rogers 2009). Remarkably, in 2002, as part of the

Restore the Oaks art installation, the outer freeway columns were painted by artists to memorialize the live oak trees that once stood on both sides of Claiborne Avenue.

After Katrina in 2005, some Tremé residents began planting trees intensively and with a sense of urgency. During interviews with members of post-Katrina tree planting groups in Tremé, it became clear that memories of the Claiborne Avenue highway development and subsequent loss of trees and neighborhood vitality were playing a large role in present day post-Katrina actions. A community elder recounted:

I am going to go further back (than Katrina)…We lost something…we had these big majestic oaks that city planning and everyone else saw fit to uproot. Along with those oaks we had inherited businesses. So that's the legacy that's lost. So, these trees (we are planting) might be a reminder of what we lost, so that we don't ever forget it and don't let that happen to us again, as well as kind of light a fire under us to ensure that we won't have to worry about a legacy being lost (due to Katrina).

Another community elder related:

We remember, just about five short blocks from here, we have Claiborne Avenue, which was a beautiful corridor of oak trees that, it's unfortunate, but the government came through with the interstate, and they knocked all the trees down…it destroyed the neighborhood; by destroying two hundred or three hundred year old trees, they destroyed the neighborhood. We need to do the opposite of that.

Finally, a tree planter from a neighborhood other than Tremé described the situation in this way:

…[Tremé is] the oldest African American neighborhood in the country and… it wasn't a tree neighborhood [before Katrina]… people didn't want trees…that's why they

didn't have them and then since [before] Katrina…the neighborhood organizations have come to us and have organized neighborhood plantings of trees and at first the people who were planting were kind of fighting with the people who didn't think trees belonged in Tremé … now since the trees are there, everybody's calling, they want trees. We have requests for more than 200 trees in Tremé right now and we've already planted 130 there.

In this instance, I contend that a social-ecological memory (Barthel, Folke et al. 2010) existed among Tremé residents about how trees once symbolized vitality, a healthy neighborhood. Simultaneously, community members carried a more foreboding social-ecological memory of how the destruction of their trees decades earlier amounted to the destruction of their neighborhood, creating symbolic import for the idea of not only the absence of trees, but the taking away of trees. Only a few years before Hurricane Katrina, tree symbols then reappeared in artistic apparitions meant to communicate the irony of concrete freeway supports standing where once live oaks stood (see Fig. 4.3).

Figure 4.3. Paintings of live oak trees created by local artists memorializing the loss of the trees and the tree lined boulevard in the Tremé neighborhood of New Orleans. Photo by: Jean Fahr, Parkway Partners.

Finally, the galvanizing effect of Hurricane Katrina's destruction, and seeing how others in New Orleans leveraged the symbol of trees and the ritual of tree planting to aid in recovery and rebirth, created the conditions for community members in Tremé to act upon their own social-ecological memories, symbols, and rituals and plant trees along their streets once again.

Earlier in this chapter I alluded to Victor Turner's classic on symbolism entitled *The Forest of Symbols*. To make some sense of my own growing "forest of symbols" and meanings, as briefly described above, early in this research I employed a software

content analysis tool called Leximancer[12] to visualize concepts and linkages. I used this tool as a final check on my preliminary understanding of the importance of trees and tree symbols to residents in New Orleans in the context of recovery from Hurricane Katrina. I asked a class of Tree Troopers (the class that I enrolled in) to fill out a questionnaire regarding their personal views on trees and recovery. Admittedly, the sample is biased by the fact that the participants were already clearly interested and committed to tree planting, however, the results of this analysis were startling none the less. This initial exploratory analysis of a small group of representatives of the larger New Orleans post-Katrina reforestation community of practice shed light on the way in which concepts like trees and tree planting permeate social-ecological systems and subsystems (see Fig. 4-4). After studying the visualization of concepts, closeness, and connectedness from the data, what was most striking was the closeness of concepts of trees and tree with New Orleans, homes, and neighborhood, indicating strong centrality and symbolic significance in trees and ideas of place.

[12] https://www.leximancer.com/

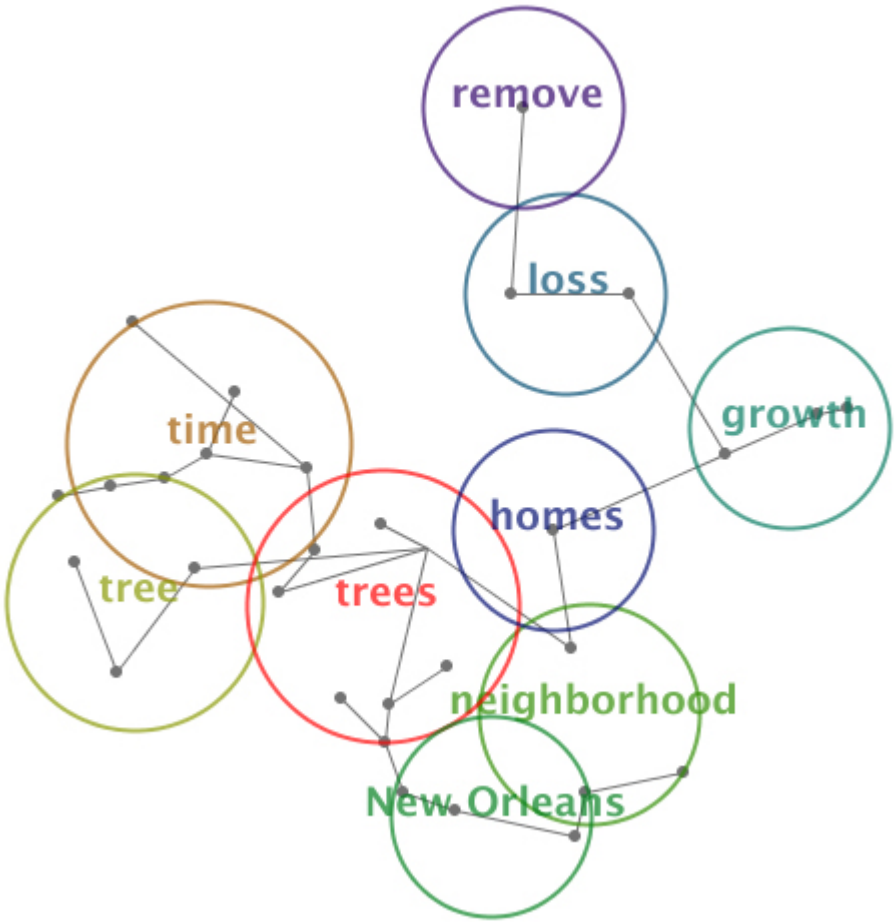

Figure 4.4 Graphic depiction of concepts, themes, connectivity, and relevance from initial interview data of Parkway Partners Tree Trooper class. Note the closeness of concepts of trees and tree with New Orleans, homes, and neighborhood, indicating strong symbolic significance in trees and ideas of place.

The founder of Hike for KaTREEna perhaps put it best when she said:

…after the storm people were looking for a way to help and planting trees is an easy way to help and it's a great way to help because you get that instant gratification but you know you get that long-term gratification too and it does mean a lot, trees do

mean a lot to people more than just "hey I'm planting something nice and green and it's going to grow," trees have a lot of symbolism.

Symbolic meanings of tree in Post-Katrina New Orleans

Consistent with the preliminary understanding I gained through participatory observation in New Orleans as briefly described above, content analysis of transcripts of interviews of NOLA residents and photo essays by NOLA residents revealed that NOLA residents have internalized multiple symbolic meanings of trees in different contexts. To make sense of this complex array of meanings of trees, the multiple symbolic meanings have been combined into intuitively formed broad families or types of symbols, and into general categories of meanings derived through multiple coding "passes" through the transcripts. Multiple instances of a particular meaning appearing in a text were counted, even when articulated by the same person more than once. This research indicated that there are three broad families of symbolic meanings of trees: (A) trees themselves as symbols (their presence, their absence, their status); (B) tree planting as a kind of symbol or symbolic action; and (C) both trees and tree planting explicitly combined in the discourse. There are 20 general categories of symbolic meanings of trees and tree planting, representing more than 70 specific and nuanced types of symbolic instances. These categories of symbolic meanings can be further separated into positive meaning and negative meaning groups based on textual analysis of interview data (see Table 4-1). A neutral group was originally included, but little if any evidence emerged indicating the usefulness of this category.

Symbol Family/Type	Gen. Category of Symbolic Meaning	Value	Occurrence
Trees	survival, stability, strength, longevity	Positive (P)	27
	sense of place icons	P	22
	hope, commitment, future	P	16
	life & growth	P	11
	memorials	P	6
	sign of return to normalcy	P	5
	therapy	P	4
	rescuer or refuge	P	2
	visual communication	P	n/a
	removal =punishment/penalty/taking	Negative (N)	16
	damaged =injury/wound/brokenness	N	11
	fallen down = damage/tragedy/loss	N	5
	falling = fear/terror danger/death	N	3
Tree planting	public service	P	18
	commitment to future	P	15
	means of beautifying	P	13
Trees & tree planting	improving environment	P	14
	positive impact on landscape	P	8
	educational	P	6
	Liability, risk, hazard, gentrification	N	5

Table 4.1. Tree symbol type, categories, meaning value, and occurrence frequency derived from interview data conducted in New Orleans.

Tree symbols with positive connotations

Trees as symbols representing positive meanings or connotations included categories such as memorial trees, trees as place icons, trees as refuge, trees as visual cues, trees as short-hand for life, growth, and re-birth, trees representing hope and optimism, trees representing stability and permanence, trees representing therapeutic healing, and trees signifying a return to normalcy. I will touch upon each of these categories briefly.

1.) Trees were frequently characterized as representing *survival, stability, strength, and longevity*, acutely legible through resident use of adjectives and phrases for trees such as survivor, survival, perseverance, safety, security, putting down roots, and the correlation drawn by residents regarding the presence of trees and well established neighborhoods.

One resident remarked:

…I know about the Live Oaks, I know about it being in City Park and Audubon Park and you know along the streets. I know we had a lot of them you know um but the thing is when I went to the Tree Troopers and they say it, how it stood up, how it survived so that's why it became a symbol.

Another resident invoking ideas of survival stated that:

…the trees represent "survival." The weak ugly tree made it, and is now beautiful, shading, etc. They survive and contribute.

A resident from a different part of NOLA said:

…a neighborhood with healthy trees just looks more prosperous to me…trees seem to have a notion of, you know, organic life.

A tree trooper said that, for her, trees represented:

…something like stability…it's settled…you know it's a settled neighborhood, that means people have put their roots down.

An elderly resident said that:

…when you pass through streets that have strong trees even the oak trees of course you know have been there a long time then you realize that people have a stake in this neighborhood and that they're there to stay and the trees show that, the trees show that when they start growing and become full adult trees and, and that they're taken care of and you know the neighborhood and the streets are lined with these beautiful trees and everything. It looks like a neighborhood, it looks like a community. You don't go anywhere in the United States and see well established neighborhoods with no trees. They all have trees so the trees represent and are symbolic of a stable community and when we can get that going in more neighborhoods then people will look at a neighborhood and say "oh this is a well-established neighborhood, I can see a lot of things happening in this neighborhood. These people are communicating, they're getting along with each other, they're planting things you know and things are going and they're moving forward in this neighborhood.

2.) Trees were often referenced as *sense of place icons*, including trees as attractors, historic trees, trees associated with oral or written traditions, favorite family or yard trees, or trees important for providing a focus for individual, familial, or neighborhood pride. For example, in one NOLA resident's words:

…we had people who were going to check on their homes for the first time with the entire family and they would do, they'd encircle a tree and claim it as theirs, as a symbol for their family, for the future, it was their tree… all of a sudden you get a whole family and they encircle the tree, it was very spontaneous on their part… they thought it was their symbol at that moment and they dedicated it to someone else who was lost in the flood you know and it's just really, it was just really a really stunning moment.

3.) Trees were frequently invoked as critically important for *representing hope, commitment, and the expectation of a brighter future*, as manifested through the celebrated presence of a newly planted tree, an old tree thought lost to salt water inundation that unexpectedly produces green leaves, flowering trees, trees bearing fruit, reports of numbers of trees planted in NOLA, and affirming reports and comments of passers-by.

Said one NOLA resident, commenting on a particularly dedicated tree planter:

…w*ell I just think that the tree is symbolic to this community effort, and it grows, and from the trees growth you can say that the community's bonds and the relationship to its own neighborhood grows… so I think that it's a good symbolic, you know, visual image of how we as a community can become closer and safer and we can help each other grow as a community.*

Another resident, trying to describe how the trees for him symbolized something inside people, said:

I'm just saying when this looked like a wasteland we were hopeful …you know, just the condition… you know immediately, you had to have this faith, this love, this belief and it's like … we're coming here, we're working and I'm just saying that you know I think the trees are a byproduct of that and not necessarily the source or the cause but a byproduct.

4.) Similar to how trees express ideas of hope, commitment, and the future, residents who were engaged in recovery and building after Katrina often cited trees as important

to them because they represent *life and growth*, including through the production of food and through visual cues, for example green as opposed to brown.

One resident interviewed said:

…the tree is really symbolic of progress and growth and as you see the tree growing you know the neighborhood is growing and changing as the tree changes each year and of course we have people who are in the neighborhood now, older citizens and then we expect the younger people to come in so you see this continuity of growth and development you see and so the trees represent that because we can see the trees as we nurture the trees and we hope people in the neighborhood will come out, take care of the trees, water the trees, do whatever they need to do to keep them growing and beautiful and so as we see this we see the neighborhood getting better and growing so it nurtures the neighborhood too.

Another resident, in the context of her temporary FEMA trailer housing in a repurposed green space, related that:

…to give you an idea of the size of the trailer, it was 154 square feet…but because of the trees surrounding us, because I could get out and walk around the grounds and stand underneath the oak trees which had not been killed, it didn't feel as small at least during the daytime.

5.) There are many cases of trees being incorporated as *memorials*, including trees as individual memorials, trees or groves as elements of mass memorials, and informal shrines. A most interesting example of this symbolic use of trees lies in the New Orleans Katrina Memorial in the Charity Hospital Cemetery[13] at the end of Canal Street at City Park Avenue, in Mid-City New Orleans (see Fig. 4-5). The memorial includes mausoleums to house the approximately one hundred unidentified and identified but unclaimed victims of Hurricane Katrina. The design incorporates the

[13] http://www.nolacemeteries.com/charity.html

shape of a hurricane and labyrinth, and trees planted and maintained by Hike for KaTREEna line the outer labyrinthine walkways. A statue of two bronze angels bearing a flaming *fleur de lis* are the focal piece in the center.

Figure 4.5. Artists rendition of Hurricane Katrina Memorial, where trees planted by Hike for KaTREEna were central design elements used to memorialize unidentified and unclaimed victims of Hurricane Katrina at the New Orleans Katrina Memorial in the Charity Hospital Cemetery at the end of Canal Street at City Park Avenue, in Mid-City New Orleans. Used by permission.

Other examples include makeshift memorials and shrines throughout the city, as well as dedicated tree memorials in parks and other open spaces.

6.) The presence or appearance of trees in a neighborhood was also mentioned numerous times as sign of a *return to normalcy* by residents affected by Katrina. One NOLA resident described how the presence of trees:

…helps to normalize, it really does you know because now… you know I'm seeing that they have planted a lot of trees on the neutral grounds out here in East New Orleans … it's great, you know, so like I said the more trees the better.

Another resident expressed optimism and determination in his understanding of how trees helped things seem to be returning to normal:

…our city used to be so much more lush with trees than it is now and I want it to come back and I know, well with time, if we just… I'll just keep planting and, and it'll get back to the way it was.

7.) Interviews, as well as participatory observation, revealed how trees were seen as *therapeutic* by many NOLA residents, helping with grieving, relieving a sense of hopelessness and despair, and contributing to other forms of coping.

One resident, describing her coping strategies in the weeks after the storm recalled how she and her husband would:

… take stale bread and go out to City Park and feed the ducks. We would walk around under the trees. That was what we did to keep our sanity.

Another resident, reflecting on the therapeutic qualities trees afforded him said:

…it makes me feel better when there are trees out there … you can rebuild a house in a year or two but, boy, it takes a long time to get a tree going, it really does… somehow the thought that you know in a couple of weeks all of those Japanese

Magnolias that we've kind of engineered around the playground are all going to pink at the same time and you're going to have sort of this life coming back to the neighborhood that doesn't look like soon to be gutted houses or yet to be gutted houses or piles of lumber or broken concrete or whatever, I mean I just, I just feel better when the trees are out here, it's not very scientific.

8.) As described earlier, trees were mentioned frequently for their role as *rescuer or source of refuge*, as in when trees were used and valorized for finding where one's home was located (see Figure 4.2), when trees were used by people to cling to in periods of high water, or when trees snagged and secured important belongings (see earlier quote by woman on Tennessee Avenue).

9.) Trees appeared frequently after Katrina as *visual communication*, in signs, art, and other visual representations such as murals and art installations or collective activist signs, in order to convey messages related to the other described positives meanings of trees (see Fig. 4.7).

Figure 4.6. Photo montage of trees appearing as symbols on murals and signs to convey ideas about resistance, recovery, and re-birth in Post-Katrina New Orleans. Photos by: Keith G. Tidball

Negative connotations of tree symbols

Trees and tree-planting as symbols representing more negative meanings or connotations included categories such as falling trees (referring to the brief period of time when a tree is actually falling, the "falling tree" invoked intense meanings among respondents), fallen or downed trees, damaged trees still standing, sick or dying trees still standing, loss of trees, tree removal, and absence of trees. As above, I will discuss each of these categories briefly.

10.) An important meaning or symbolic interpretation of trees was found in the post-Katrina *removal of trees*. This tree removal symbol was an emotionally charged one, overlapping into feelings of government neglect and ineffectiveness and signifying feelings of unfair punishment, penalty, reprisal, and taking, similar in some cases to grieving the loss of a loved one and in other cases akin to political injustice. Reflecting more political forms of signification were statements like the following:

… you had two separate and real distinct types of damage that happened from Katrina. You had the damage from the storm and the flood that killed and damaged the trees, and then you had the damage that happened from the cleanup effort… now I'm not talking about a church group from Ohio, I'm talking about every guy that's got a chain saw and a pickup was all of a sudden a tree company… They didn't have any rules and regulations to go by so there was a lot of confusion… the way that FEMA ran the cleanup operation totally emasculated our existing arborist's companies… and the FEMA people who had little or no technical knowledge contributed to the loss of tree canopy in post-Katrina NOLA, a significant loss of tree canopy or trees that need not have been lost.

Another person commented that:

…the problem after the storm was unlicensed arborists were allowed to come into this city and just whack away at the trees… a licensed arborist from Michigan or wherever would come in and cut those trees to the specifics of what they were accustomed to doing in their area. They didn't know anything about live oaks and how it has to spread. They didn't know the live oak doesn't wave in the wind and wouldn't take down that wire. They didn't know the live oak, that the tree has the right-of-way[14], the wires are secondary that, that's full on in New Orleans.

Reflecting feelings of something being taken, and the associated feelings of loss and grieving were the thoughts of this NOLA resident:

[14] New Orleans has ordinances regulating treatment of trees rooted in public property or rights-of-way, including green strips between sidewalks and curbs. State-licensed arborists are supposed to be hired in the event that such trees must be pruned. Penalties are to be paid in the event that trees are damaged. See New Orleans Code of Ordinances Chapter 106, Article IV.

We had a 50-year-old Magnolia in front of our house and after 6 weeks of sitting in brackish water it was a 50-year-old dead Magnolia and that was one of the most heartbreaking things was to have to cut that tree down because we had watched it get bigger. We probably lived in the house for 25 years, watched it get bigger… that tree was planted in about 1950 when this neighborhood was developed um and it had been there and it was so massive that it was taller than the house and we watched generations of squirrels grow up in that thing, in that tree, we watched them build a nest, we watched, we fed the squirrels, we had um mourning doves and cardinals and blue jays, there was an entire ecosystem in that tree and that was our pride and joy right in front of the house and when we came back it was a dead tree (clearing throat).

11.) Damaged but still standing trees represented a separate kind of symbol, with overtones of meanings involving concepts such as *injuries, wounds, brokenness, exploited vulnerabilities, weaknesses*, as well as feelings of disgust and feelings of being overpowered. One resident expressed his feelings of double disappointment by the loss of trees and the remaining vestige of them: *"…they were ugly, you know what, what are you going to do with stumps?"*

The feelings of shock when trees needed to be trimmed or otherwise manipulated due to damage or prevention of damage also invoked meanings as described above. A Tree Trooper remarked:

Katrina came and the tree didn't fall even though while I was gone my husband was concerned that any limbs would cause some damage so he did have somebody to come in and trim and it's like golly, it's so ugly to me you know?

Another resident conveying succinctly the feelings around the symbolic power of dead trees said: *"I'd rather have no trees than a dead tree."*

12.) Some residents described how fallen or downed trees symbolized for them broader feelings of *damage, tragedy, and loss* brought about by hurricane Katrina. One elderly gentleman, struggling to control his emotions talked about how he:

… had to remove broken trees that meant something special—[trees planted when we] first moved in, child born, got cancer, loved one died…

Another resident described the scene after the storm had dissipated:

Once we got to the city road, it was like somebody had dropped matchsticks, I mean all the telephone lines were down, wires were everywhere, trees were down, I mean you couldn't even see the street, all the trees were down and my first thought was this is like a really bad Armageddon movie.

The language of many residents' "storm stories" has the marks of the sign/signifier relationship described earlier, such as this survivor's comment that the downed trees were:

…the most immediate visible sign of destruction after the storm. I guess it also had to do with my previous relationship to trees and woods and the peace and grounding I often found in those environments and the realization that the one thing that grounded me and gave me comfort and security had just been totally destroyed in a matter of hours and that I had just had a front row seat to that destruction. I suppose the bottom line was that if I was going to be ok then I had to do something about making the trees ok.

13.) Many residents described the terror and sense of helplessness they felt when they observed a *tree(s) being uprooted, or snapping, and falling down.* This negative meaning of the symbol of tree is an example of how the destruction of a symbol with a positive meaning itself can become a negative symbol.

I asked one resident what was the worst part of enduring the storm as it was unfolding. The response was:

…the hours riding out the storm were spent watching the trees fall down and break and uproot and for all those hours that the storm lasted all I heard was the constant sound of the trees falling and breaking.

Another resident described the effect the storm's lashing of the tree's had on her:

The woods and the trees, it was decimated …that was the first, I mean I'd seen trees fall, I'd seen somebody cut a tree and heard it fall and hit the ground and I was like wow, that is, that's powerful, that's strong … but to see mother nature do it and to see the trees sway and sway again and sway again and then just to snap… that was amazing; or to see it you know just be totally uprooted and fall and crash… it's just unbelievably powerful. There's nothing you could do about it.

Tree planting symbols with positive connotations

The act of tree planting as a symbolic act, or ritual, included categories of meanings that overlapped in some case with those above, such as demonstration of hope and commitment to the future, a means of beautifying the neighborhood, and a form of public service.

14.) The act of tree planting and the presence of tree planting events also were repeatedly referenced as symbolic of a kind of *duty and public service*. One volunteer, engaged in a massive college service day involving tree planting, commented:

…it's cool because we're going to be out here for a couple hours and I mean altogether we're planting 250 trees, something like that, and just bringing back that whole idea of you know you can, even if we only plant 2 trees today, that makes a

difference, you know, going back to just a couple people working together doing, you know, even a small thing. This happens to be a huge [planting] *day, but she* (Monique of Hike for KaTREEna) *goes out there and plants in much smaller quantities … it's just one person making a difference and here in this city in general you really see that a lot and it's exciting you know.*

15.) The act of tree planting and the existence of tree planting events and artifacts were reported to serve as a visual signal for all to view, and a *demonstration of commitment to the future*. One resident described how:

…the trees are, well you know you plant a tree and there's such a significant accomplishment, you just feel so good, it makes you feel good and when you see it it's there, it's not like you know you have a flag on your house… it might take 6 or 8 months to get the rest of the house and you're still waiting for a check and you can't get the Road Home[15] *to give it to you and you have lots of obstacles, but you do have your trees in your neighborhood and you can look down that street and you can see that "okay we are making progress … the trees are back, there's some houses here, and it's starting to look like my place again, it's starting to be my home again.*

A young person, discussing trees and hope, said:

Well for me it's been a total change from feeling kind of like negative feelings about driving around the city and feeling kind of negative about all the, you know, devastation and everything…starting to plant trees has made me totally feel positive and hopeful and like I'm actually making, you know, helping with the solution and not just sitting around grumbling.

16.) The act of tree planting and the existence of tree planting events served as a means of *beautifying a neighborhood*, which appeared in the preliminary content analysis adjacent to ideas of alive (see p. 123). One NOLA resident explained:

[15] The Road Home program is the largest single housing recovery program in U.S. history and is designed to provide compensation to Louisiana homeowners affected by Hurricanes Katrina or Rita for the damage to their homes. See https://www.road2la.org/about-us/default.htm

…it just seemed like a good idea. Why wouldn't you plant trees if you could, I mean you, you know you look at streets that look good, they've got trees on them right? They've got to get there somehow.

Another resident elaborated on trees and neighborhood beautification:

I begged the volunteers when they came by… I didn't realize they were going to put some new trees on the neutral ground which we really needed in this block. I guess we lost more than I thought. A neighbor across the street planted those 3 cherry trees and I'm just delighted in seeing them bloom.

Positive connotations of trees and tree-planting combined

In some cases, the interview data yielded instances where residents held ideas about tree and tree-planting meanings that could not be easily separated into either solely tree meanings or solely tree-planting meanings, indicating that distinctions between tree symbols and tree rituals may sometimes blur, or be unclear. Some of those cases are elaborated below.

17.) *Improving the environment*, especially creating shade and wildlife habitats, appeared frequently as positive connotations of both trees themselves and the act of planting trees. Residents expressed great love for their birds and squirrels, and missed them in the weeks and months after Katrina. They hoped that trees would bring them back (see photo essay 1, below). It is important to note that many residents felt it was important for their feelings not to be interpreted as environmental as such, as illustrated by the following two quotes from interviews:

…people talk about the shade but not because they're coming from an environmental perspective… they're talking about being a New Orleans resident and how hot it gets

during the summer and how they remember when they had trees they had a cool place to go and it's, it's the same benefit but it's being seen culturally from a different perspective. It's being called by a different name.

And similarly,

…nobody here ever talks about global warming. I don't hear in conversation people speak about global warming but they talk about patience and wisdom and their grandmothers and they talk about what their homes looked like before Katrina and the amazing trees they had before Katrina. Nobody's ever talked to me about the environmental benefit of it. They talk about the personal benefit of it and wisdom and patience and, and investment for their children. All of these things come up.

18.) The combination of trees as symbols and the symbolic rituals of tree planting were mentioned frequently by residents as symbolizing a *positive impact on the New Orleans landscape* over time. These observations were often linked with ideas about trees and tree-planting as short-hand for investment and value in a community. One prominent resident comparing well-off neighborhoods with less prosperous ones said:

The Marigny [a middle class racially diverse neighborhood] *has beautiful sidewalks and functioning gutters and drainage system and trees and St. Roch* [a lower income, predominantly black neighborhood] *doesn't have those things at all… it's very easy for children to see that and I think that that affects self-esteem and a sense of self-worth…like how their community values them and looks at them and they get an idea of that from the block that they're growing up on and the area directly around them and where their friends are and if they can walk directly across St. Claude* [the street dividing the two neighborhoods]*and see something totally different where a different race of people live, that it is very damaging. That makes them go to school feeling like they're not being invested in… so if we could get sidewalks and proper drainage systems and trees in St. Roch...*

19.) Trees as symbols and the planting of them were also thought of as important for *providing educational opportunities* for members of the New Orleans community after

Katrina. One neighborhood leader, recognizing the power of curiosity commented that:

…when people like neighbors in the community see you out with a project like this, this always draws attention and they come out and they want to ask questions and find out what's going on and it's a way to educate the community.

A leader in the community talked about education and the value of education to empower community advocacy, saying:

…we started off in education first… the model that we used was to train a representative from every area so they could be the advocate for the trees in that neighborhood …they got to be damn good… they are the only group to ever, ever, ever, ever in the history of the city who sat down city representatives and said "It doesn't make sense what you want to plant" and the city listened. They heard them.

Negative connotations of tree-planting symbols

20.) A small number of residents felt that trees meant for them *risk, or stood for liability or hazard*. One resident commented that:

There's some people who are cutting down trees now because they fell, because they were afraid they were going to fall again, you know they lost something, part of their house was lost and so now they're tearing down trees and they, I mean they miss them, they feel bad but they feel like they have to do that and, and we really do need to educate them that if you have a healthy tree so protect your house it's not going to hurt your house.

Another resident shared his assessment of these kinds of feelings and meanings about trees:

There's people that are cutting down all the trees all around their property because there may have had one pecan tree fall on their house and it's going to take a long

time to educate them …but a lot of people speak beyond just technical storm liability and how trees can help.

The primary negative symbolic meaning associated with tree planting had to do with residents' concerns that tree-planting indicated active or forthcoming gentrification and displacement in their neighborhood. A neighborhood elder confided that:

A lot of people see trees as gentrification of their neighborhoods and prices will go up and then the rich people want to move in and it will [cause us to] *lose our identify.*

The relationships between wealth, identity, and trees need further research.

Corroboration via photo essay

Though the interview data as described above appeared to provide convincing evidence of the many important symbolic and ritual meanings carried by trees and tree planting in the post-Katrina New Orleans disaster context, and the importance of reforestation rituals emerging and embedded in the dispersed reforestation community of practice, further corroboration was required to better capture these ideas from the perspectives of NOLA residents as seen in their own eyes, and in their own words. To these ends, the following section presents 2 images and accompanying descriptions as seen and captured from the eyes of NOLA residents themselves. This aspect of the research is used to suggest possible interconnections and relationships across themes derived from the interviews, and to seek elaboration, illustration, and clarification of the results of interviews and participant observation. The photo-essay elaboration provided in this chapter is minimal and intended only to supplement and augment the

qualitative interview data (but see Tidball & Stedman, in preparation, for a focused study on trees and post-Katrina recovery using exclusively photo-essay methods).

Photo Essay 1

Figure 4.7. Dedication of Donnelly Park in Burbank Gardens, New Orleans, LA, January, 2011. Brass band welcomes guests in front of the largest surviving oak. You can't drown the music or the spirit of the neighborhood. Photo and caption by New Orleans resident.

The thing that hurt the most was (and still is) seeing all those stumps from the dead trees. With diameters wider than my reach, those trees were planted 60 years ago when the area was developed. Shade that covered entire houses is now gone, cardinals no longer sing to me in the morning, and entire families of squirrels that regularly raided my bird feeder have vanished without a trace.

On our first trip home after the storm we got lost while returning to a house we had lived in for 25 years. The trees I had used as landmarks had been chainsawed down, including the two redbuds I had planted in front of our house. Our 50 year old magnolia had survived the winds intact, but had drowned in the brackish floodwaters. You can demolish and rebuild a house in less than a year, but how do you rebuild a tree?

Living in a 154 square foot trailer for 2 ½ years while we rebuilt left me searching for ways to keep sane and connected. When Parkway Partners showed up at a neighborhood meeting looking for volunteers to plant trees, I leapt at the chance. Upon completion of my tree trooper training, I received a diploma, a baseball cap, and a shovel with my name on it. Since then I have planted trees in Musicians Village and on wide medians along Elysian Fields, Broad Street, and Paris Avenue. I find myself driving along those streets just to check out the progress of the trees, and I am often amazed at how well they have taken root and are growing.

New Orleans is a new city since Katrina. Young people are flocking here and becoming invested in the city's future. New trees are taking the place of the older ones which were lost. My husband jokes that in years to come, someone will point me out as the old lady who planted all those trees.

The trees in the pictures I sent are in Donnelly Park, just across the street from my house. Although I did not plant any of them, they are some of my favorites. Looking out of my kitchen window I can see the beginnings of a small forest which was not there before the storm. We will appreciate the value of all that shade around July, when the summer sun would have turned that old playground into a well baked vacant field. Already we have homes being built on the neighboring streets because of their proximity to the park.

When something like a hurricane knocks you out of your orbit, you must find a new compass to regain your balance. Planting trees has rooted me even more firmly to my neighborhood, has introduced me to neighbors I would never have met otherwise, and has become my investment in the future of this city. Hopefully one day someone will sit under one of those trees and wonder where they all came from, and wherever I am I will be smiling, because I will know the answer.

Photo Essay 2

Figure 4.8. One of many trees planted by a New Orleans resident as a response to Hurricane Katrina… "a symbol of the New Orleans I love – flexible, colorful, enduring, and none too upright." Photo and caption by New Orleans resident.

As I drove up to my home after Katrina, the first thing I saw was that my now leafless live oak was still standing. I stepped out of my car and went to touch the trunk, looking upward to see what damage it had sustained, not realizing until then how much I valued that tree. A large loblolly pine on the front lawn stood tall, broad and graceful and I was proud that its root plate did not look "rocked" – I trimmed it out for high wind events. But I ultimately cut it down two years after the storm with the rationale that it was too tall, the tallest tree in the neighborhood. I lived in fear during lightning storms that it would draw the strike due to its heavy resin, or that was what I told myself. I felt hollow inside as it was removed and still question did I do it in some irrational post-Katrina fear that it would fall on my house?

And then I went crazy planting native trees that I love on my front lawn: a longleaf pine, parsley hawthorn, red buckeye, eastern redbud, fringe tree, flowering crabapple

and even a couple of non-natives. I'm determined to give up grass and restore a mini-forest where that massive pine once was – and they are so lovely – but there is still regret.

The planting of trees confirms that I am staying, putting in roots, reclaiming land that seems a bit more dear. Why the over-kill on planting every type of tree I love? I realize the magnitude of the tree loss in New Orleans and must make up for this. Maybe the trees are a symbol of the New Orleans I love – flexible, colorful, enduring, and none too upright.

Discussion

The relationship between humans and trees, the symbolic meanings of trees as objects and the meanings associated with their planting and care in the wake of a disaster, and the implication of these symbols and interactions on the resilience of perturbed social-ecological systems (SES) is the subject of this chapter. As described earlier, rituals can be understood as storehouses of meaningful symbols by which information is revealed and regarded as authoritative, as dealing with the crucial values of the community (Turner and International African Institute 1968:2; Deflem 1991). In post-Katrina New Orleans, reforestation activities emerged as rituals by which information that represented a counter-narrative to news media and others who spoke of New Orleans as a "failure of resilience" (Westrum 2006) was revealed and regarded as authoritative. Post-Katrina reforestation rituals acted as storehouses of multiple meaningful tree symbols dealing with crucial community values and concepts such as place attachment and sense of place, resilience and resistance, hope and commitment, and survival and stability. But tree planting rituals and the symbols contained in them reveal more than crucial social values. They are also transformative for human attitudes and behavior, and therefore the handling of tree symbols in ritual exposes the power of tree symbols to act upon and change the persons involved in ritual performance. Whereas NOLA residents may have been attracted to tree symbols and rituals for reasons such as

biological impulses combined with socio-cultural phenomena, for instance, recalling social-ecological memories (Barthel, Folke et al. 2010), involvement in memorialization mechanisms (Tidball, Krasny et al. 2010), or the clear connection of trees to notions of stability and re-birth, the data presented here suggest that subsequent participation in tree planting rituals appears to change the persons involved such that they experience renewed hope, optimism, and sense of commitment to their neighborhood and to their city, important indicators of community resilience. I have documented how NOLA residents organized around a particular area of knowledge and activity (trees and tree planting) and developed or reconstituted rituals and symbols that at once reinforced and reinvented the accumulated knowledge of the community via a distributed community of practice centered on trees and tree planting after Katrina. This, I argue, contributed to enhancing a sense of joint enterprise and identity, and therefore contributed to the resilience of the NOLA social-ecological system. NOLA residents also continue to plant and steward trees, directly adding to the biomass, future urban tree canopy, and the potential capacity of the urban social-ecological system to produce critical ecosystem services (Al-Jiburi, Campbell et al. 2009). In so doing tree symbols, tree planting rituals, and those involved in them simultaneously present both a source of and a demonstration of individual, community, and social-ecological system resilience.

The analysis of the data presented here describes trees as symbols with multiple and interrelated meanings, and describes tree planting rituals as outgrowths from these tree symbols, which gives credence to the hypothesis that the presence of tree symbols and tree rituals is of importance to resilience and the process of recovering from a specific disaster or crisis, such as Hurricane Katrina in New Orleans in 2005. Based on the data presented herein, tree symbols and rituals, and how tree symbols and rituals are

remembered, reconstituted, and reproduced, represent a cluster of social mechanisms that can be viewed as "tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience" (Berkes and Folke 1998, pp. 21-22). For New Orleans to continue to build resilience through the experience of the disturbance of Hurricane Katrina, multiple cross-scale activities are required (Ernstson, Leeuw et al. 2010), but for this to occur, sufficient memory from both ecological and social sources for reorganization must be present (Berkes and Folke 2002). Thus, I argue, the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components, feedbacks and cycles catalyzed by these relationships, and so on, all contribute to system memory, processes involved in "regeneration and renewal that connect that system's present to its past" (Gunderson, Pritchard et al. 2002, p. 264) and aid in conferring resilience.

Conclusions

Over the last several decades, there has been a debate within the social sciences regarding the relationship of humans and their environments, the extremes of which are characterized by two positions: that people are either agents of landscape degradation or are landscape managers who sustain and increase biological diversity (Lepofsky and Kahn 2011). While I agree with these scholars that realistic models of human-environmental interactions should recognize that individuals and collectives within societies are neither exclusively environmental stewards nor the agents of detrimental ecological changes (Lertzman 2009), I take most from Lepofsky and Kahn's (2011) assertion that there is limited value in models of human-environmental interaction that "vilify the elite and glorify all commoner behaviors" (p. 331). In Post-

Katrina New Orleans, people from all walks of life, various ethnicities, and economic status, from the homeless guerilla gardener to the movie star Brad Pitt, all of whom have inevitably engaged in both landscape degradation and healthy landscape management in the past, came together around a few poignant and multifaceted symbols to form a distributed community of practice and associated symbols and rituals having to do with trees and recovery from a disaster.

This chapter's intent was to describe trees as symbols and tree planting rituals, and to describe the importance of the presence of tree symbols and tree rituals to the process of recovering from a specific disaster or crisis, Hurricane Katrina in New Orleans in 2005. Further, I endeavored to delineate the role of the relationship between individuals or communities and trees and forests, especially in symbolic and ritualistic terms, as an important part of individual or community recovery, and of the resilience of the social-ecological system within which human individuals and communities are embedded. The presence of tree symbols, the social-ecological memories that define them and that inform the rituals that perpetuate them, and the resulting social-ecological relationships between people and trees or forests, as expressed through symbols and rituals, reveals a possible source of resilience in this kind of SES undergoing rapid change.

The broader implication of such a conclusion is that the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components, feedbacks and cycles catalyzed by relationships among trees, forests and humans, all contribute to regenerative system memories, that form a bridge from that system's present to its past (Gunderson, Pritchard et al. 2002, p. 264). When a system "remembers" system properties, such as

human-nature interactions that produce, restore and enhance mutually beneficial outcomes for biophysical and psychosocial elements of the system, and those system memories are subsequently reified through social-ecological symbols and social-ecological rituals, a unique possibility for social-ecological system resilience is introduced. Human-nature interactions, particularly those of a class of human-nature interactions called civic ecology practices (Tidball and Krasny 2007) such as community reforestation, enhance the ability of people in red zones to organize, learn, and act to increase their capacity to withstand, and even grow from, rapid change and uncertainty through nurturing cultural and ecological diversity, through creating opportunities for civic participation or self-organization, and through fostering learning from different types of knowledge.

The research and policy implications and questions of a conclusion such as the above are multiple. Are the findings from this study in post-Katrina New Orleans generalizable? I would answer "maybe," and we need to find out. Clearly there is a need for further study of red zones where this or related phenomena may be observed and better understood. If this phenomenon is recurring, what and how might policy makers plan differently in terms of inevitable disasters and potential conflict? The importance of rapid responses to facilitate ecological discoveries from major disturbances has been well argued (Lindenmayer, Likens et al. 2010). However, the corresponding importance of rapid responses to facilitate *social*-ecological system discoveries from major disturbances, including documenting human-nature interactions such as the importance of trees and tree-planting as symbols, rituals, and the formulation of communities of practice with broad ramifications for SES resilience, is only recently beginning to be discussed. It is my hope that this

exploration of the symbols and rituals that emerged around trees in the recovery of New Orleans will add something of value to such discussions.

Coda

Reflecting on the role of trees as symbols in disaster contexts, it is impossible not to consider what has recently happened in Japan, in the wake of a massive earthquake and resulting tsunami and nuclear crisis that caused the death of over 22,000 people. As I write, the annual Cherry Blossom festival is underway in my former neighborhood in Washington, DC. The trees were a gift from Japan almost 100 years ago. For many, according to a news article in the Washington Post (Ruane 2011) "the trees actually symbolize renewal, rebirth… and now more than ever, again rebuilding for the Japanese." The trees blossoms are heavy, and they fall to the ground soon after they bloom, observes James Ulak, senior curator of Japanese art at the Freer Gallery and Sackler Gallery in Washington, D.C. "Japanese poets from early on took this as analogous to the ephemerality of life," he tells National Public Radio's Linda Wertheimer, "and this blended with a strong Buddhist notion of transience: things are passing, nothing is permanent" (National Public Radio 2011). The Washington Post (Ruane 2011) news article goes on to quote the president of the Japan-America Society of Washington, who specifically relating tree symbolism to the resilience of the people of Japan, said: "if ever there is a time when Americans think about Japan, it's when the trees are blooming. From that point of view, the cherry blossom festival this year has a very special meaning for all Americans, because it's a chance for us to think about Japan and what has happened there and to do something about it…the

Japanese people, I've never known anyone more resilient than they are, after what they went through in World War II, and they got back up on their feet." The importance of trees as symbols, especially in the context of catastrophes, cannot be understated.

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CHAPTER 5

PAPER IV- POSITIVE DEPENDENCY AND VIRTUOUS CYCLES: FROM RESOURCE DEPENDENCE TO RESILIENCE IN URBAN SOCIAL-ECOLOGICAL SYSTEMS

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Abstract

We argue that purely-deficit based perspectives regarding urban social-ecological systems (SES) and the human populations within them represent barriers to these systems' ability to move from undesirable system states into more desirable, sustainable ones. We characterize issues such as individual ecological identity, human exemptionalism, anthropocentrism, and resource dependence. We examine notions found in the resource dependency literature, where we trace the roots of ideas about dependency. We use this literature as a spring board into the possibilities of an antipodal notion of resource dependency that may be applicable in urban contexts, what we call positive dependency. Next we describe two possible sources of positive

dependency in urban SES, urgent biophilia and restorative topophilia, followed by a brief discussion applying positive dependence to urban systems challenges and management. We conclude with the importance of a recognition of positive dependency as a precursor to the development of a heightened sense of ecological self and sense of ecological place in urban SES, and provide suggestions for further research into civic ecology practices that may enhance positive dependency on and investment in ecological assets that contribute to positive ecological senses of self and place, and the importance of these to resilience in urban systems.

Key Words

positive dependency, ecological identity, urban social-ecological system resilience, virtuous cycles, civic ecology, resource dependence

Introduction

The field of ecological economics endeavors to provide a better understanding of economic relationships between people and between people and their environments, which may lead to ecologically better economic behavior (McMahon 1997). For this to occur, however, the field of ecological economics must be able to adequately theorize these relationships. As McMahon points out, “economic man has trouble with relationships” (Ibid. p. 163). In this contribution, we attempt to address a handful of related issues that we have termed, perhaps somewhat tongue-in-cheek, “relationship problems” involving humans and social-ecological system sustainability and resilience

in urban contexts, including the linked problems of negative (or non-existent) ecological identity, sometimes referred to as ecological selfhood (Bateson 1972; Bateson 1979; Naess 1988; Macy 1991; Clayton and Opotow 2003) among humans (especially urbanites) and how this sometimes appears in the misapplication of resource dependency theory and attendant problems (Humphrey, Berardi et al. 1993; Freudenburg and Gramling 1994). Specifically we explore these so-called relationship problems having to do with our understanding of our relationship of ourselves to our local environments, our individual ecological selves, and our understanding of our relationship as a species to the biosphere via the notion of resource dependency as applicable in urban contexts. In so doing we hope to address gaps in ecological economics studies that "appear inattentive to the ways in which socially defined resources are components of complex, highly dynamic biophysical systems… [whose] resilience may depend on entities and processes far removed from human economies" (Sneddon 2000, p. 528).

Discussions of social-ecological system (SES) sustainability and resilience in urban contexts often revolve around attempts to better understand, quantify, and appreciate ecosystem services provided to human communities within urban social-ecological systems (Bolund and Hunhammar 1999). Not inappropriately, in many discussions about urban system sustainability, a great deal of attention is given to the mostly negative effects of anthropogenic change in urban SES. As a case in point, the first sentence of the book An Introduction to Ecological Economics (Costanza, Cumberland et al. 1997) states: "…the recognition by humans of their impact upon the earth has consistently lagged behind the magnitude of the damage they have imposed, thus seriously weakening efforts to control this damage" (p.1). Often overshadowed by

this problem of assumed negativity regarding humans and nature are the positive actions humans sometimes take in the systems in which they live that contribute to virtuous cycles that produce, or significantly enhance production of ecosystem services and other positive social and ecological outcomes (cf. Barlett 2005; Tidball and Krasny 2008; Krasny, Tidball et al. 2009). To fully appreciate these human initiated virtuous cycles requires viewing humans as part of ecosystems, and then viewing their activities and social behaviors, much like we are accustomed to doing for other terrestrial life, as merely parts of a larger whole, rather than as distinctly separate, and therefore unlinked or de-coupled, systems. This requires description of the relationships between "dynamic human economic systems and larger dynamic, but normally slower-changing ecological systems" (Costanza, Daly et al. 1991, pp. 8-9).

In this contribution we speculate that purely deficit-based perspectives regarding urban SES and the human populations within them represent barriers to these systems' ability to move from undesirable system states into more desirable, sustainable ones. In other words, so long as humans view themselves solely as distinct, or worse, distinctly negative, within their SES, they are considerably hampered in their ability to visualize and actualize the transformation called for in sustainability and resilience discourses. We feel that an exploration of the positive attributes and characteristics of humans in urban SES, within the contexts of the relationship problems such as are manifested by ideas of dependence as outlined above, is a worthwhile endeavor in efforts to reintegrate humans with the rest of nature (Costanza 1996) and a unique contribution to this special issue.

Stephen Kellert muses in his book Building for Life that " a pervasive loneliness and self-hatred sometimes seem to have afflicted humanity like a virus that imperils our

species" (2005, p. 217), leading to a kind of "human-nature apartheid" (Hettinger 1996; Rees 2003). We begin our approach to these relationship problems characterized by human self-image issues by elaborating upon them. We briefly characterize issues such as forgotten individual ecological selfhood, human exemptionalism, anthropocentrism, and resource dependence. We then examine notions found in the literature on resource dependency, where we trace the roots of ideas about our dependency. Then, we move to use this literature as a spring board into the possibilities of an antipodal notion of resource dependency that may be highly applicable in urban contexts, what we call positive dependency (Stedman and Tidball 2008). Next we describe two possible sources of positive dependency in urban social-ecological systems, urgent biophilia (Tidball 2012 and Ch. 4 this volume) and restorative topophilia (Stedman and Ingalls in press), followed by a brief discussion applying positive dependence to urban systems challenges and management. We conclude with the importance of a recognition of positive dependency as a precursor to the development of a heightened sense of ecological self and sense of ecological place in urban SES, and provide suggestions for further research into civic ecology practices that may enhance positive dependency on and investment in ecological assets that contribute to positive ecological senses of self and place, and the importance of these to resilience in urban systems.

Terms and Assumptions

Consistent with others in this special issue, we view resilience as the ability of a SES to absorb unexpected perturbations and to sustain its fundamental functions, structure, identity, and feedbacks through recovery or reorganization in a new environment (Holling 1973; Walker, Holling et al. 2004). A form of interaction that implies

resilience are virtuous cycles or feedback loops, which are argued to be foundational to social-ecological systems resilience thinking (Gallopin 2002; Powell, Selman et al. 2002; Matthews and Selman 2006; Selman 2006). There are cycles and feedbacks that are termed vicious because they produce fundamental change in the system and transition the system to different states with different properties and characteristics. According to Varis (1999, p. 599), if their direction of influence is negative, they are considered vicious cycles, and if their direction is positive, they are known as virtuous cycles. These virtuous and vicious cycles provide a means to visualize how urban environmental stewardship might interact with other processes to help transform a social-ecological systems.

We concur with Warner and Kuzdas' (2010) assessment that a more narrowed definition of resilience specific to urban environments is desirable, and their consequent modified definition of urban resilience from Ernstson (2008) is useful: "urban resilience is the capacity of a city to sustain a certain set of urban subsystem services, in the face of uncertainty and change, for the inhabitants of the city" (p.1). This definition lends itself to application because of its requirement for assessment efforts to analyze "not only how urban subsystems are managed, but also which urban subsystems are prioritized" (Ibid.). However, it would be improved by clarifying exactly which "inhabitants of the city" are of primary concern. We feel strongly that the exclusive prioritization of human inhabitants actually contributes to erosion of resilience in urban SES, and point to social-ecological feedbacks wherein human and other inhabitants of urban SES may be better and more completely accounted for in efforts to enhance urban social-ecological system resilience, rather than simply or solely the resilience of contemporary human society.

Relationship Problems – Forgotten Individual Ecological Identity: Human Exemptionalism, Anthropocentrism, Resource Dependence, and Associated Ills

According to Rees (2003), modern humans are unaccustomed to conceiving of themselves as ecological or biological entities. It is as if we as individuals—and indeed, entire societies -- have forgotten our ecological identities, or are suffering a kind of environmental amnesia, enduring a self-imposed humanity-nature apartheid (Hettinger 1996), a legacy of the enlightenment in western culture's reductionist mindset that sees the human enterprise as somehow separate from and above (or below) the natural world (Hayward 1994). This can seem especially obvious in urban contexts. Here we arrive at the first of our relationship problems alluded to in the opening paragraphs of this contribution. There appears to be a problem with our understanding of ourselves as individuals and as a species in relationship to the rest of nature, upon which we ultimately depend. How did we get here?

Ecological Identity and Human Exemptionalism

In his thorough review of ecological paradigms in anthropology, Hardesty (1980) concludes that there are significant problems of analysis that must be overcome before a satisfactory explanation of the place for the physical environment in theories of human behavior is convincing, problems such as proximate and ultimate causes, time scale, and linkages between individuals and larger units of analysis, among others. He argues that human ecology should not be placed in a subservient role to the ecology of other species, but should strive to become a full partner (Hardesty 1980). Other

anthropologists echo this sentiment (cf. Abel and Stepp 2003). As a sort of clarion call, Costanza proclaims that "…as one of the dominant species of animals on the planet, Homo sapiens and its relationship to its environment is obviously well within the scope of ecology by any of its various definitions" (1996, p. 978), inviting multidisciplinary approaches to human and nature relationships and ecological identity.

Researchers from many disciplines are engaged in studies of aspects of ecological identity, such as philosophy (Merchant 1992), psychology (Axelrod 1994; Stern and Dietz 1994), biology (Wilson 1984; Wilson 1993), social ecology (Kellert and Wilson 1993; Kellert 1997a; Kellert 1997b), so-called "deep ecology" (Naess 1988), ecospsychology (Roszak 1992; Thomashow 1995; Winter 1996; Thomashow 1998), environmental justice (Clayton and Opotow 2003), and ecological anthropology (see Ch. 4 this volume). In its most extreme conclusion, this research claims that our loss of an ecological identity, or the "… failure of many humans to locate themselves ecologically has contributed directly to the current ecological crisis" (Kretz 2009, p. 116). Although a clear and rigorous definition of ecological identity has yet to emerge, Clayton and Opotow bring us close in stating that environmental identity includes "the way in which we define the environment, the degree of similarity we perceive between ourselves and other components of the natural world, and whether we consider nature and nonhuman natural entities to have standing as valued components of our social and moral community (Clayton and Opotow 2003, p. 8). Clayton goes a step further when she proposes that environmental identity is "one part of the way in which people

form their self-concept: a sense of connection to some part of the nonhuman natural environment, based on history, emotional attachment, and/or similarity, that affects the ways in which we perceive and act toward the world; a belief that the environment is important to us and who we are" (Clayton 2003, pp. 45-46)

There is also an important symbolic component to ecological identity. Our surroundings impart to us signals that inform us about who we are. Recalling psychological research on "place attachment" (Altman and Low 1992; Jorgensen and Stedman 2001; Stedman 2002) and place identity (Proshansky, Fabian et al. 1983) connectedness to particular environmental aspects of places people have lived often shape self-definitions (Eisenhauer, Krannich et al. 2000; Stedman 2003). Further, people may define themselves by virtue of the ways that they interact with their environment through their roles as hikers, hunters, lake dwellers, homeowners, (Greider and Garkovich 1994) and in urban contexts as tree planters and custodians, community gardeners, or watershed protectors (Krasny and Tidball 2009b; Kudryavtsev, Stedman et al. 2011; Ch. 4 this volume).

In contrast, human exemptionalism separates the human from natural worlds by privileging human consciousness and the societies that it produces as unique and distinct, an anthropocentric tendency of humans for centuries (Williams 2007). To provide historical perspective, over twenty years ago in his review of "unecological" traditions and perspectives in modern social science, Dunlap (1980) pointed out that social scientists tended to focus more on values, economic organization, culture, or

technology, and not on the relationship between a society and its biophysical environment. He went on to describe how different social sciences manifested human exemptionalism. Within sociology, Dunlap argued, social organization and technology are assumed to maintain a human population within carrying capacity of its environment, thus ensuring successful adaptation, as alluded to by the early work of Hawley (1973) and others. For the field of anthropology, Dunlap continued, "culture" will insure that a population adapts well to its environment; for political science, it is the political system or "polity" that regulates human societies to insure their successful adaption; for economics, not generally concerned with broad adaptation, the focus is upon insuring an adequate resource base for continued growth. Therefore, in the sphere of economics, technology and the institution of the market will produce an infinite supply of substitutable resources, making resource scarcity all but impossible (see Simon 1980 for a classic argument in this vein). All of the above treatments by social science, argues Dunlap more than a quarter century ago, tend to assume that human mechanisms- social institutions, culture, technology, and so on- insure that humans will adapt successfully to their environment. Importantly, Dunlap clearly articulates how this amounts to denial of the possibility that humans could fail in their efforts to adapt to changing environmental conditions, including changes brought about by humans themselves, and how this involves the assumption that, unlike other species, humans are exempt from ecological constraints.

In the twenty-first century, we have in important ways begun to escape the human exemptionalist paradigm, in favor of a new ecological paradigm (Dunlap and Van

Liere 1978; Dunlap 1980; Dunlap and Catton Jr 1994; Rideout, Hushen et al. 2005; Manoli, Johnson et al. 2007) and partially reflected in the pursuit of ecological economics (Costanza, Cumberland et al. 1997; Rockström, Steffen et al. 2009). However, even today, many social scientists are of two minds about this debate. As Williams (2007) explains it, on one hand, scholars point out that the market, a social institution, causes significant amounts of environmental disorder, yet on the other hand some of these scholars suggest choice and rationality can fix these problems. We see this because, as Murphy (1995) and later Abel and Step (2003) recognized, a strong bias persists in the social sciences for perspectives that prioritize agency and the power of social actors. But, Williams counters, even in the predominately secular thinking of sociology "agency has a mythic grasp … to question our ability to choose and to choose rationally is to question the exemptionalism of our consciousness; it is to question our humanity and the self-conception of ourselves as special and unique creatures of evolutionary history" (Williams 2007, p. 138). Williams states emphatically that mythical ideas have no place in a non-exemptionalist and scientific view of social and environmental interaction. As Dunlap and Catton have asserted, "the welfare of human beings is inextricably interrelated with the condition of our earthly habitat and that the increasingly problematic nature of this interrelationship cannot simply be deconstructed" (1994, p. 24).

And yet we find human exemptionalism creeping in other forms, too. Where humans were once thought, for better or for worse, to transcend nature (cf. enlightenment literature and art), we find some now arguing that we humans are anathema to nature

(cf. Cole and Landres 1996; Cronon 2003 describes this problematic perspective but does not advocate for it). This ironically anthropocentric argument is seen in assertions that humans are somehow to be excluded from "real" nature, from pristine nature, from wilderness (Neumann 1998). These arguments and assumptions are more subtle, but in the end continue the anthropocentric tendency to place humans outside of the environment, contributing to de-linking, de-coupling, and alienating humanity from its ecological home. This insidious mirror image of the human exemptionalism described above positions humans as phage, as virus, as infection of an otherwise healthy system. Where once we were gods, now we are demons

We must pause here to briefly acknowledge the downside of overcoming anthropocentrism. As Hayward (1997) says, "the aim of overcoming anthropocentrism is intelligible if it is understood in terms of improving knowledge about the place of humans in the world" (p. 61). However, Hayward cautions that we must be cautious about "unwittingly projecting human perceptions on to beings whose actual perceptions may be radically different, since this would be to reintroduce just the sort of error that characterizes ontological anthropocentrism" (Ibid.)

Resource Dependency

A common current flowing through the above relationship problems is the way we as individuals and as communities tend to frame ourselves in relation to what we need from nature. One established current of thought in sociology has to do with resource dependency, a dependency on some element of the ecosystem to maintain or enhance

well-being of humans, at the individual and collective level. The argument goes like this: the more that humans depend on certain natural resources, especially for tangible needs, the more those humans become vulnerable, the more their resilience is compromised. So in essence, the argument runs, the less we are forced to depend upon nature, the better off we are. We turn now to a discussion and critique of resource dependency as it reflects this more subtle form of human exemptionalism.

Neil Adger, while exploring the dependency of social systems on the environment, asked whether communities and institutions which are directly dependent on natural resources are themselves linked to the resilience of the ecosystem and whether there are direct linkages between ecological and social resilience (Adger 2000). The extensive literature on resource dependent communities, especially those based in dependency on the extraction and processing of raw materials such as forest or subsurface mineral resources, suggests that when social systems depend on a single resource or environmental attribute, they tend to be more likely impoverished (Elo and Beale 1985; Machlis and Force 1988; Machlis, Force et al. 1990; Humphrey, Berardi et al. 1993; Nord and Luloff 1993; Freudenburg and Gramling 1994; Peluso, Humphrey et al. 1994; Overdevest and Green 1995; Stedman, Parkins et al. 2004; Stedman, Patriquin et al. 2011) and less resilient to sudden changes (Adger 2000; Adger, Hughes et al. 2005). Such thinking has spawned a generation of research addressing the well-being of natural resource "dependent" communities. However, statements about the relationship between dependence and well-being are highly

contingent upon the meaning of the word "depend." If the word is operationalized in the narrowly circumscribed domains of livelihood and income (Stedman, White et al. 2007; Stedman, Patriquin et al. Forthcoming for a critique of these definitional approaches), often in purely pejorative terms, then the observation is difficult to contest. Yet, if the word "depend" is allowed to also encompass its more positive meanings and domains, the conclusion that resource dependency leads to depleted social-ecological system resilience is more difficult to defend, and open to reflection and theoretical and empirical examination.

Perhaps it would be useful before going further to "unpack" this word depend. Studies of the well-being of resource dependent communities have incrementally expanded the definition of "dependence": from economic dependence on the direct extraction and local processing of timber products (using forest dependence as an example); to economic multipliers derived from these activities; to economic dependence on a broader range of non-timber forest products and/or forest-based tourism; to socio cultural dependence on forests for symbolic individual or community identity (see Stedman, White et al. 2007).

Even these nascent expansions, however, hold fast to what might be termed "negative" definitions of dependency, where community dependence is antithetic to "independence" and oft-synonymous with weakness and "addiction". This implies a narrowed range of local opportunities, economic linkages, and community development efforts, and increased vulnerability and exposure to broad social and

economic change. Communities that are more dependent, according to this view, are less sustainable, less diverse and less resilient.

As described above, the phrase “resource dependency” has its origins far from the city, in the field of rural sociology, as exemplified most strongly in (Humphrey, Berardi et al. 1993; Freudenburg and Gramling 1994) and is strongly tied to the extraction and processing of raw materials such as forest products, oil and gas, hard rock mining, and fishery resources. Studies of resource dependency deploy the term “resource” to encompass a host of environmental attributes, so long as they represent instrumental utility to humans, usually based in employment and/or income, and often link extraction to poverty (Elo and Beale 1985; Humphrey, Berardi et al. 1993; Freudenburg and Gramling 1994; Stedman, Parkins et al. 2004, and others). However, a more general notion of resource dependency can be understood to be a description of the unique relationship between the users of environmental attributes and the environmental attribute itself (Force, Machlis et al. 1993; Bailey and Pomeroy 1996; Krannich and Zollinger 1997). Examples of communities dependent upon one or more environmental attributes are typically communities that are predominately farming, mining, fishing, or logging communities (Bailey and Pomeroy 1996). Some more recent scholarship now considers natural resource tourism and recreation as a type of resource dependency (cf. Mattarrita-Cascante, Stedman et al. 2010). Others focus on the role of availability of natural resources in fueling armed conflict and vulnerability (LeBillon 2001), taking us still further away from the extraction criterion for understanding resource dependency. Thus, in broad terms, according to some

scholars, a change in the nature of the relationship between users and a resource has the potential to inadvertently jeopardize or compromise societal prosperity and affect the ability of social and ecological systems to be resilient (Boserup 1981; Burdge and Vanclay 1996; Farmer and Albrecht 1998; Adger 2000).

We contend that the above statement only tells part of the story, the story emphasizing resource dependency and its companion outcome, poverty. Though we agree that changes to the relationship between users and a resource might sometimes bring negative consequences in the case of "extractive" or "consumptive" resource dependency, we contend that it is conceivable that sometimes changes in the nature of the relationship between users and a resource have the potential to not jeopardize or compromise, but to enhance societal prosperity and affect the ability of social-ecological systems to be resilient, thus telling the other side of the story, that of resource dependency and well-being.

A key consideration is the term extraction and its implications for understanding the unique relationship between resource users and a resource. Perhaps the best effort to date in synthesis of the notions of resilience and resource dependency comes from Marshall and colleagues (2007a; Marshall and Marshall 2007b), who developed a conceptual model of resource dependency in terms of: 1. occupational attachment, 2. attachment to place, 3. employability, 4. family attitude to change, 5. business size, 6. business approach, 7. financial situation, 8. level of specialization, 9. time spent harvesting, and 10. interest in and knowledge of the environment. They then tested

their model of resource dependency and its effect on social resilience (quantitatively and qualitatively) using the commercial fishing industry in North Queensland, Australia. Their results show that occupational attachment and employability were important influences as were business size and approach.

The findings of Marshall et al. (2007a) regarding occupational attachment are particularly relevant to this contribution's argument. These scholars claim that resource users can become dependent on a natural resource due to their level of attachment to their resource-extractive employment. They argue, consistent with others, that work can affect resource users so that their work relationships, interests and values permeate their lives outside of work (Becker and Carper 1956; Hughes 1958; Salaman 1974; Gonzalez and Benito 2001). Marshal et al. (2007a) posit that when people with a strong occupational attachment suddenly discover that they can no longer continue in their current occupation, they lose both an income, and a valuable part of their self-identity. But is there an alternate conclusion to be drawn? If our goal is to increase stewardship for the ecosystem and appreciation for resulting ecosystem services, and beneficiaries of the ecosystem and its elements become especially dependent on a resource or service because of their level of attachment to their ecosystem-oriented occupation, and these beneficiaries can be affected by their work in such a way that their work relationships, interests and values permeate their non-working lives, is it possible that this scenario presents a potentially opportune situation?

Enter Positive Dependency

We return to Adger's important questions about whether communities and institutions that are directly dependent on natural resources are themselves linked to the resilience of the ecosystem and whether there are direct linkages between ecological and social resilience (Adger 2000). Though the literature on resource dependent communities described earlier suggests that when social systems depend on a single resource, they tend to be more likely impoverished and less resilient to sudden changes, given that this statement is highly contingent upon the meaning of the word "depend," might there be examples of communities that are highly dependent upon environmental attributes being highly resilient? As discussed earlier, if the word "depend" is operationalized in the narrowly circumscribed domains of livelihood, income, and over-exploitation, often in purely pejorative terms, then it is difficult to contest. Yet, if the word "depend" is allowed to also encompass its more positive meanings and domains, the conclusion that resource dependency must lead to depleted social-ecological system resilience is more difficult to defend.

Let us then briefly consider another, more positive, class of synonyms for dependence - faith, trust, hope, and confidence - the implications of which have been largely ignored in the literature on resource dependence. What might be the potential utility and implications of these definitions of dependence? Is it possible that this kind of resource dependence may lead to another class of outcomes? Can community "faith" in a resource serve as a springboard for asset based community development efforts, and imply something very different about the relationship between dependence and ability to cope with change through stewardship, memory, and learning?

We have earlier speculated (Stedman and Tidball 2008) and wish to further refine here the concept that some of the lack of recognition of the potential for positive dependence lies squarely within traditional operationalizations of dependence that are wholly consistent with the scholarly traditions of rural sociology. Careful readers will have noted two potential tensions, one dealing with scale (the individual versus social aggregates such as communities), and the other with whether dependence is conceived (and measured) as a psychological state or behaviorally. The implications are illustrated in table 5.1, below.

The rural sociological literature on the well-being of resource dependent communities emphasizes - especially in measurement of aggregate levels of poverty - the community rather than individual level of analysis. This stands in contrast to our foregoing discussion of dependence as something that an individual actor can do: a *person* "depends," as surely—likely more than—a community, which represents an aggregation of heterogeneous hopes and dreams. Closely related, but analytically distinct, is whether dependence is to be conceived and measured as a quasi "behavior" (i.e., as indicated by employment) or a psychological state, as we allude to above.

	Individual	**Community/Aggregate**
Psychological (pos / neg)	Attitudes: Negative: Risk aversion, unwillingness to change Positive: attachment, biophilia	Social representations, community identity: Negative: "we are" backward, with few other options, stuck. Positive: shared vision, collective identity, community as special place
Behavioral **(pos / neg)**	Individual actions: Negative: disinvestments in human capital based on faith in industry or lack of awareness of options Positive: use "faith" in the resource as a launching pad for creativity, entrepreneurship, etc.	Secondary data: indicators of community action Negative: disinvestments in alt development strategies Positive: community-driven initiatives: resource based development strategies, CBRM

Table 5.1. A conceptual typology of dependence.

Simply put, we believe that the traditional treatment within rural sociology on looking at dependence as a collective quasi "behavioral" state (*communities* depend, and this dependence is indicated by the employment of their residents) has contributed to the relative lack of recognition of the potential for the positive dependence such as we describe.

Sources of Positive Dependency: Urgent Biophilia and Restorative Topophilia

One possible source of positive dependency may be an inherent compulsion to affiliate with other life, what E.O. Wilson called biophilia (Wilson 1984). Here, we invoke biophilia as a proper *philia*, referring to inherent affinity for life, or love of life and other living systems, with life as the focal point, while rejecting purely biologically deterministic conclusions some have drawn from Wilson's work. Integrating Wilson's

early notions of biophilia with more recent research on positive responses to, or perhaps a positive dependence upon, plants and green spaces in urban post-disaster settings, the following explanation for an "urgent biophilia" has been proposed (Ch. 3 this volume). During more stable times, we humans exhibit varying degrees of affinity for nature at what Wilson and others (Kellert and Wilson 1993) argue is a mostly sub-conscious level. We often use gardening and other forms of nature stewardship to recover from personal hardship. However, in times of surprise and rapid change, human and nature interactions and the positive emotions they elicit may compellingly and suddenly come to the fore in heretofore unexpected ways, and be manifested in immediate and conscious actions, often beyond merely individuals, to include neighborhoods, communities, and whole societies (Ch. 4 this volume). Further, such manifestations of affinity for nature after surprise and rapid change, urgent biophilia, may play a critical role in the ability of humans and larger social-ecological systems to demonstrate resilience. This switch from base-line sub-conscious biophilia (what Wilson argues is genetic, but could be explained in other ways; see for example Kellert 1997a; Kellert 1997b) during times of growth and stability, to conscious urgent biophilia during times of collapse followed by reorganization reflects cyclic changes described as the adaptive cycle in social-ecological systems resilience writings (cf. Gunderson and Holling 2002 and p. 74, this volume). Once surprise and change threaten to "flip" an urban social-ecological system into a less desirable state, humans may respond to feeling threatened or a sense of loss by seeking physical and emotional affiliation with other living organisms, and in so doing, may aid themselves, as well as other parts of the system, in recovery. Should this urgent biophilic response and positive dependence upon cultural services provided by ecosystems and their elements also include individuals working collectively to enhance their local environment, e.g., through community forestry and community gardening, it may further contribute to

recovery of other ecological elements of the larger urban social-ecological system. Although this urgent response does not necessarily take us in the direction that Wilson and others envisioned when proposing biophilia (i.e., furthering the claims of sociobiology or conservation of biodiversity), it may have implications for better understanding human-nature interactions and positive dependence upon cultural services of ecosystems perturbed by surprise and sudden change, and the relationship those human-nature interactions have to social-ecological resilience.

Restorative Topophilia (see Stedman and Ingalls in press) represents an opportunity for positive dependence that underpins the emergence of virtuous cycles. Here we draw upon Yi-Fu Tuan's (1974; 1975; 1977) notion of topophilia (literally "love of place") which emphasizes a social actor's attachment to place and the symbolic meanings that underlie this attachment. Topophilia is conceived and operationalized as strongly experiential and "constructed" rather than innate. Relph (1976, p. 141) emphasizes that places are "fusions of human and natural order…significant centers of experience…based on directly experienced phenomena of the lived world, full of meanings, with real objects, and ongoing activities, and become important sources of human existence with deep emotional and psychological ties." This attachment is based on the meanings we attribute to them (Stedman 2003; Stedman 2008). Tuan wrote (1975) "an object is taken as a symbol when it casts a penumbra of meanings" (p. 23). The diverse and symbolic nature of these meanings has fostered a debate about whether these meanings are radically individualistic or are social and widely shared. Some (Relph 1976; Meinig 1979) go so far as to assert that a given setting will contain as many meanings as there are people within it. Others, however (e.g., Greider and Garkovich 1994) suggest that while a given setting embodies multiple meanings, they are based on roles and hence shared by others who occupy similar roles.

Stedman and Ingalls (and others, see Vaske and Kobrin 2001; Kudryavtsev, Stedman et al. 2011 for example) suggest that topophilia can and often does serve as a powerful base for individual and collective action that repair and/or enhance valued attributes of place, hence our term “restorative topophilia.” It is crucial to remember, however, that these restorative actions are based not only on attachment - people fight for the places they care about - but also on meanings, which define the kinds of places people are fighting for.

Restorative topophilia is, clearly, a form of positive dependence, manifesting hope and faith in the connection between people and environment. It contributes to virtuous cycles in several ways: first, by the direct effects of the actions in which people engage to enhance their place. The biophysical environment can be improved through civic ecology practices (Tidball and Krasny 2007; Krasny and Tidball 2010): parks and gardens created, streams cleaned, and trees planted. Second, and perhaps even more crucial, through restorative topophilia, place attachment is facilitated by the individual and collective action itself, through the building of networks. Participants themselves become engaged with others (including those who do and do not hold place meanings that are consistent with the goals of the activity). In this way, virtuous cycles of trust, collaboration, social learning, and other forms of capacity building are constructed, which provide a firmament from which additional actions can be taken (Stedman, Lee et al. 2009). Often, these effects “spill over” to envelop non participants—in the particular activity-- as well by increasing levels of social cohesion, community capacity, and trust, thus enhancing the emergence of virtuous cycles.

Implications for Urban Systems

Beyond the academic objective of recasting resource dependence theory in new urban constructs and contexts (Alberti, Marzluff et al. 2003; Alberti and Marzluff 2004; Elmqvist, Colding et al. 2004; Barthel, J. Colding et al. 2005; Alberti 2008; Ernstson, Leeuw et al. 2010) lies the larger reality of a disturbingly dystopian vision of an urbanizing planet (Davis 2006) and the realization of the dawning of the anthropocene (Crutzen and Steffen 2003; Steffen, Sanderson et al. 2005). It is against this backdrop, and the many iterations and implications of it bombarding men, women and children around the world that we make the claim that purely deficit based perspectives regarding urban SES and the human populations within them represent growing barriers to these systems' ability to move from undesirable system states into more desirable, sustainable ones. If we humans continue to view ourselves solely as "bad actors" then we cannot act surprised at self-fulfilling prophesies. As this vicious cycle spirals out of control, we are considerably hampered in our ability to visualize and actualize the transformation called for in sustainability and resilience discourses.

Social-ecological system analysis emphasizes, among other things, that systems should be characterized by their feedbacks, their reinforcing mechanisms that tie the social and ecological system together in patterns of co-evolution (Berkes and Folke 1998; Gunderson and Holling 2002). As Ernston argues (2008, p. 34), "*urban* systems are different from non-urban systems in that their direct *dependence* [our emphasis] on tangible products from local ecosystems are [sic] weaker" and "… the range of choices of how to use land is greater (producing heterogeneity)…" Further, we would add that not only are urban systems different in that they may depend less on tangible (extractive) products, they may, we argue, depend more on intangible elements of

local ecosystems, those things labeled as “cultural ecosystem services” (cf. Millennium Ecosystem Assessment 2005).

Examples of “positive” resource dependency, not surprisingly, often occur in urban community forestry contexts, when the act of being involved in urban community forestry as well as the resulting increase in the urban forest and its attendant ecosystem services is directly related to urban social-ecological system resilience, especially in the wake of a significant perturbation such as a disaster (Tidball and Krasny 2007; Tidball in press B). Specifically, the presence of trees, and the opportunity for humans to interact with them, as passive observers and appreciators, but more importantly as active managers and stewards, may contribute to resilient communities and cities (Tidball, Krasny et al. 2010). In contexts such as urban landscapes where there are somewhat limited opportunities to relate to environmental attributes or amenities, an opportunity to rely or “depend” upon a natural resource, or even an opportunity to extract benefit in the form of urban ecosystem services, can potentially increase social and perhaps ecosystem resilience, rather than contribute to higher levels of poverty and lower resilience to sudden changes.

Conclusion

Ecological economics was conceived, in part, to “reconcile humankind with the rest of the natural world” and endeavors to treat humans “… not as outside nature, but rather as integral components of, and active participants in, the ecosystems that support them…” (Rees 2003, p. 4). Building on this, we have attempted to demonstrate that despite these best efforts at reconciliation, humanity seems still to be handicapped by unreconciled “relationship problems” when it comes to human and nature relations.

Though we as a species seem to need to be reminded of the damage to the biosphere of which we are capable, our discourse seems to have crossed over into deficit-based negative self-image and self-castigation, or self-hatred as Kellert (2005) described it, a vicious cycle. Nevertheless, humans show signs of reconciliation when they acknowledge and act upon urgent biophilia and restorative topophilia, impulses that lead to civic ecology practices, enhanced ecological identity and the development of beneficial positive dependency.

If we accept the possibility of positive dependency, its utility as a concept to the field of environmental economics and even more broadly is readily apparent in efforts to think through and manage the challenges of urban sustainability and resilience. Positive dependency enables an alternate path out of the deficit-based thinking that forecloses the emergent and catalytic potential of human and nature interactions in cities, chiefly the starting, re-starting, or expanding of virtuous cycles that confer desired resilience. This can act as a precursor to the development or recovery of a heightened sense of ecological self and sense of ecological place in urban SES.

The implications of the above are urgent needs for further research into documenting and describing cases of urban positive dependency, and research on civic ecology practices that may enhance positive dependency on and investment in ecological assets that contribute to positive ecological senses of self and place, and the importance of these to resilience in urban systems. A demand exists for transdisciplinary qualitative and quantitative methods and approaches that document and interpret linkages between individual ecological identity and community ecological sense of place, and their relationships to collective action for sustainable urban systems.

Positive dependency as a concept allows us to escape the misguided conclusions potentially drawn by resource dependence arguments that the more that humans depend on natural resources, especially for tangible needs, the more those humans become vulnerable, the more their resilience is compromised. While attempting to recover or reconcile our relationship with nature, we may not need the contradictory message that “the less we are forced to depend upon nature, the better off we are” rattling around our heads. Rather, we can benefit by contributing to the evolution of resource dependency thinking to include the at once simple yet profound idea that “the more we acknowledge our dependence on nature, especially in urban contexts, the more resilient we can be.”

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CHAPTER 6

PAPER V- DETECETING VIRTUOUS CYCLES THAT CONFER RESILIENCE IN DISRUPTED SOCIAL-ECOLOGICAL SYSTEMS

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Introduction

New Orleans is said to be home to some of the largest collections of mature trees in the world, representing nearly 50 species, including magnolia, pine, live oak, bald cypress (Louisiana's official state tree), and red maple (Goudarzi 2006). Historically trees have held special symbolic significance to residents of New Orleans, contributing to identity and sense of place (Anderson 2004; Nell Greenfield Boyce 2005; Kearns 2006). Residents returning to New Orleans after the 2005 hurricane "Katrina" shared many stories with first author Tidball about the New Orleans landscape before the hurricane, the role that trees played in their lives, how after the storm they used trees as landmarks to find the place where their home once stood, and

how the surviving trees gave them hope that they too would persist, would persevere, and would maintain their roots in New Orleans.

Tidball (Tidball and Krasny 2008b; Tidball 2009; Ch. 4 this volume) has described elsewhere how the role of the relationship between individuals or communities and trees, especially in symbolic terms, is an important part of individual or community recovery and resilience after a disaster. This importance of trees has been related to notions of sense of place in other hurricane ravaged cities (Hull 1992), as well as considered a part of community healing rituals and memorialization in post- 9-11 New York City (Tidball, Krasny et al. 2010). Here we argue that such symbolic relationships with trees that result in widespread citizen led reforestation projects catalyze social-biological *feedbacks* and set in motion *virtuous cycles* in perturbed social-ecological systems (SES) that confer resilience. Given this argument, we ask: how do we locate feedbacks and identify virtuous cycles so that managers can avoid pathologies of natural resource management (Holling and Meffe 1996) and instead reflect adaptive reorganization represented by the presence of virtuous cycles?

Much has been written about larger anthropocentric drivers of ecosystem processes in economic contexts (Hidalgo and Hausmann 2009), including market forces (May, Levin et al. 2008), urban planning (Pickett, Cadenasso et al. 2004), sprawl (Batty 2008), large scale watershed degradation (Costanza, Voinov et al. 2002), and their predictably negative implications. However, relatively little has been said about the role of beneficial human activities, especially urban ecological restoration activities

like urban community forestry or other urban community greening activities, and their role in overall urban SES health and resilience. We call these kinds of practices civic ecology (Tidball and Krasny 2007; Krasny and Tidball 2010; Krasny and Tidball 2012), which will be explored in further detail in the following pages. If, as is so often argued, human activity is the most important driving factor in urban SES (Elmqvist, Alfsen et al. 2008), then perhaps it is important to explore how human activity like urban community forestry might contribute positively to virtuous cycles and feedbacks within systems, thereby, even if only incrementally, contributing to resilience in urban social-ecological systems. It is this premise that is the focus of this paper, sheds light on gaps in current understanding, and gives rise to the question we raise herein.

To answer the question "how do we locate feedbacks and identify virtuous cycles," in this synthesis paper we review feedbacks and virtuous cycles catalyzed via ecological restoration in order to highlight their importance to SES resilience, offer conceptualized and diagramed virtuous cycles, briefly describe an example where restoration activities and civic ecology practices contributed to feedbacks and virtuous cycles, discuss approaches for recognizing and investing in virtuous cycles that accompany SES, and define approaches for managing for the eventual emergence of virtuous cycles.

Feedbacks and Related Concepts: Review and Definitions

Collins et al. (2000) point out that though the term "urban ecology" was coined by sociologists who sought to use ecological theory to describe human behavior in the urban setting, we are now attempting to integrate human-dominated ecosystems into ecology itself. Until recently, relatively little ecological research was conducted in urban settings (McIntyre, Knowles-Yanez et al. 2000). Ecologists have sought to understand their subjects of study in the absence of humans and generally considered humans chiefly as agents of disturbance (Pickett and McDonnell 1993; Costanza 1996). However, we take the view that humans and the rest of nature continue to interact and form a system with properties and processes that shape urban ecology (Grimm, Grove et al. 2000; Elmqvist, Colding et al. 2004; Borgstrom, Elmqvist et al. 2006; Folke 2006).

Social-Ecological Systems and Resilience

The “resilience perspective” is said to have emerged from a stream of ecology that addressed system dynamics, ecosystem dynamics in particular (Folke 2006). According to Folke human actions have been thought of as a central part of understanding the capacity of ecosystems to generate natural resources and ecosystem services for some time. Folke goes on to explain that the early inclusion of humans as agents of ecosystem change distinguished this ecosystem oriented branch of ecology from mainstream ecology. Mainstream ecology treats human actions as external to the ecosystem. Consequently the human interactions and feedbacks between ecosystem development and social dynamics have not been frequently explored and analyzed.

Thus, according to Folke (Ibid.), the resilience perspective "evolved out of observation, using models as a tool for understanding and for incorporating actors and interest groups in adaptive management and learning of ecosystem processes" (p. 262).

Our use of the term resilience refers to the capacity of linked social-ecological systems to absorb disturbances so as to retain essential structures, properties, and feedbacks and continue to develop and innovate (Holling 1973; Walker, Holling et al. 2004; Adger, Hughes et al. 2005). Resilience reflects the degree to which a complex adaptive system is capable of self-organization and building capacity for learning and adaptation (Carpenter, Walker et al. 2001; Folke, Carpenter et al. 2002). Again, we view humans as integral to the ecosystem and one of the main "inter-actors" that shape the system's self-organization. Consequently ecosystem services in the urban landscape are generated by interacting social-ecological systems and not by ecosystems alone (Niemelä, Breuste et al. 2011).

Feedbacks, Virtuous Cycles, and Systems

Within the general field of systems theory, systems are viewed as the product of components interacting which leads to internally self-organized systems (Holland 1995; Levin 1999; Levin 2005; Folke 2006). A form of interactions that imply resilience are virtuous cycles or feedback loops, which are foundational to SES resilience thinking (Gallopin 2002; Powell, Selman et al. 2002; Matthews and Selman 2006; Selman 2006). Vicious feedbacks, on the other hand, produce undesirable

fundamental change in the system and transition the system to less desirable states (but nevertheless still potentially resilient) with different properties and characteristics. According to Varis (1999, p. 599), if their direction of influence is negative in relation to a desired system state, they are considered vicious cycles, and if their direction is positive, they are known as virtuous cycles. These virtuous and vicious cycles provide a means to visualize how urban ecological restoration might interact with other processes to help transform a social-ecological system. For example, some urban systems may be characterized as experiencing vicious cycles of poverty leading to crime and environmental degradation, which in turn foreclose economic development opportunities (also referred to as poverty or lock-in traps, cf. Allison and Hobbs 2004). However, it is within these same impoverished neighborhoods that community members sometimes "self-organize" to restore trash- and crime-ridden vacant lots, transforming them into community gardens and pocket parks, which become sites that foster social capital and provide ecosystem services (Bolund and Hunhammar 1999; Barthel, J. Colding et al. 2005; Ernstson, Barthel et al. 2010; Ernstson, Leeuw et al. 2010). Such civic ecology practices (Tidball and Krasny 2007; Krasny and Tidball 2010; Krasny and Tidball 2012) may be one factor that helps to "flip" these systems from a vicious cycle of urban decay to a more virtuous cycle of urban rebirth, a concept we will return to shortly.

The notion of feedbacks in systems is frequently employed in climate studies (Rosenfield, Rudich et al. 2001), such as between vegetation and P dynamics in tropical dry forest (Lawrence, D'Odorico et al. 2007), and in ecosystem resilience

studies such as in coastal and seagrass ecosystems (Sunda, Graneli et al. 2006; T. van der Heide, E. H. van Nes et al. 2007), earth sustainability (Rockström, Steffen et al. 2009), and urban ecosystems (Grimm, Grove et al. 2000; Grimm and Redman 2004), among others. As Folke notes (2006), SES in particular exhibit strong reciprocal feedbacks (Costanza, Low et al. 2001; Gunderson and Holling 2002; Berkes, Colding et al. 2003; Janssen, Kohler et al. 2003; F. S. Chapin III, Peterson et al. 2004). These feedbacks and their cross-scale interactions in relation to resilience are relevant when modeling SES with multiple stable states (Carpenter, Brock et al. 1999; Janssen and Carpenter 1999; Janssen, Walker et al. 2000; Carpenter and Brock 2004; Bodin and Norberg 2005).

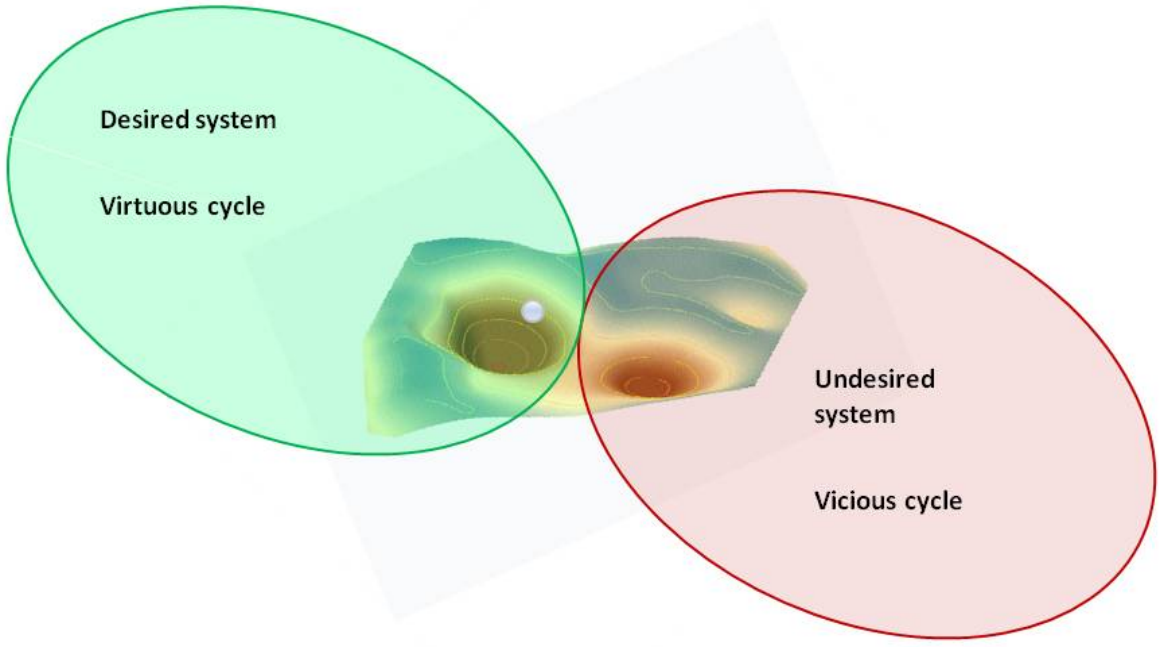
Conceptually, the feedback concept is central to social-ecological systems resilience and other systems dynamics approaches. Yet we acknowledge that heuristic or metaphorical diagrams of loops of information feedback and circular causality are imperfect tools for conceptualizing the structure of a complex system and for attempting to communicate model-based insights. As Richardson (1986) points out, causal-loop diagrams such as depictions of feedback loops and cycles can be problematic in that they blur distinctions between information links and rate-to-level links. Reinforcing loops (vicious and virtuous cycles) can be either sources of growth or sources of accelerating collapse; they are disequilibrating and destabilizing, consistent with resilience as described by Holling (1973).

Virtuous and Vicious Cycles- Application

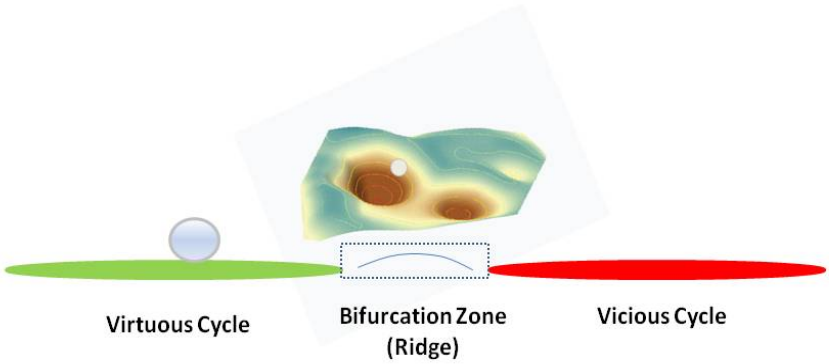
In the above section, we briefly reviewed and defined key systems thinking concepts, such as social-ecological systems and resilience, and feedbacks and cycles. In this section we expand these definitions, particularly in the area of vicious and virtuous cycles. Cycles are recurring series of successive interactions or states. In ecology, cycling refers to the movement of chemicals or substances through an ecosystem (e.g. nitrogen cycle). We take the former view of cycles and define a cycle as a stable state with recurring variation. Vicious cycles (Gallopin 2002) represent one stable state within a landscape (cf. Beisner, Haydon et al. 2003). Any one ecosystem might also contain other possible stable states, such as virtuous cycles of people stewarding green space or natural resources, which thus provides greater access to nature and contributes to community and ecosystem well-being (Suutari and Marten 2007; Tidball and Krasny 2008b). Depicted graphically, a vicious cycle can be imagined as a ball that is constantly swirling around one basin within a landscape, and our goal is to move that ball to a different basin that represents a virtuous cycle and a more desirable state (Figure 6.1). To move the ball to a different basin requires either moving the ball itself through making changes within the basin (e.g., increasing the magnitude of the restoration activities) or by changing features of the landscape (see Scheffer, Carpenter et al. 2001; Walker, Holling et al. 2004 for a more thorough description of stability landscapes and basins of attraction). For example, one can envision a “ridge” or bifurcation zone, separating the two basins, and that by reducing the height of the ridge it becomes easier to move the ball from the vicious cycle to the virtuous cycle

basin. In this metaphorical model, the ridge could represent legal or policy barriers, unfavorable public opinion, competition for scarce resources, and so on. Altering the ridge might require an influx of resources from outside the vicious cycle, such as an influx of outside money or change in government policy (Figure 6.2).

Fig 6.1 A stability landscape illustrating virtuous and vicious cycles as alternate possible domains.



Adapted from pp 53-55 in Walker, B.H. and D. Salt. 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World.* Island Press, Washington, D.C., USA and http://www.resalliance.org/index.php/key_concepts.



Adapted from pp 53-55 in Walker, B.H. and D. Salt. 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World.* Island Press, Washington, D.C., USA and http://www.resalliance.org/index.php/key_concepts.

Fig 6.2. A focus on the bifurcation zone or "ridge" between virtuous and vicious cycles as represented by stability domains.

Examples of vicious cycles and cascading effects in SES context abound. Carpenter and colleagues (2006) pointed out how ecological feedbacks may intensify human modifications within ecosystems. We know that ecological change can alter the flow and reliability of the supply of ecosystem services that people receive from nature (Kumar 2010). These ecological changes may, in turn, increase the vulnerability of people and ecosystems to further changes (Cumming, J. Alcamo et al. 2005; Carpenter, Bennett et al. 2006). Examples include decreases in coastal area resilience due to removal of large-bodied predators (Jackson, Kirby et al. 2001), and decreased coastal area resilience leads to increased vulnerability to storms and tsunamis (Adger,

Hughes et al. 2005). As Carpenter and colleagues (2006) note, these kinds of feedbacks and associated cascading changes can cause major shifts in the availability of ecosystem services, which then alter social dynamics in ways that intensify ecosystem change—a vicious cycle. Figure 6.3 below represents a general hypothesized vicious cycle in a given urban SES.

Examples of virtuous cycles in SES contexts are less apparent and less readily available, in part because they represent a counter-discourse regarding the role of humans in ecosystems as generally negative. However, it is not difficult to at least imagine virtuous cycles given the above. One must simply imagine the opposite of a vicious cycle and its associated feedbacks and cascading changes. To do this, one must first break down the elements of a vicious cycle so that one can then substitute virtuous analogs. We can see in Figure 6.4 below that the elements of the hypothesized virtuous cycle appear to be analogs of the above depicted vicious cycle.

In previous work, Tidball and Weinstein have identified virtuous social-ecological feedback loops as the defining characteristic of truly sustainable strategies (Weinstein and Tidball 2007; Tidball, Weinstein et al. 2008; Tidball and Weinstein 2011). In scientific terms a positive feedback loop is a phenomenon in which information of the consequences of a behavior or event cause the behavior or event to repeat itself with even greater magnitude.

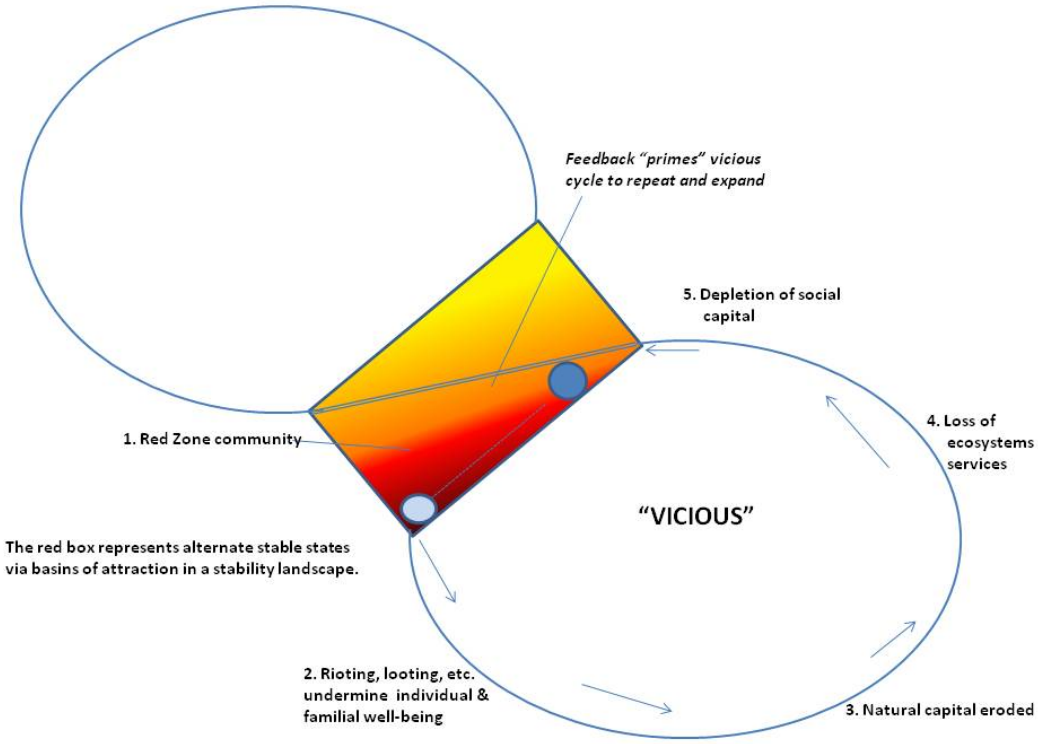


Fig 6.3 An example of a vicious cycle. A similar version of this graphic appears in: Tidball, KG and ME Krasny (2011). Toward an ecology of environmental education and learning. *Ecosphere*, 2(2).

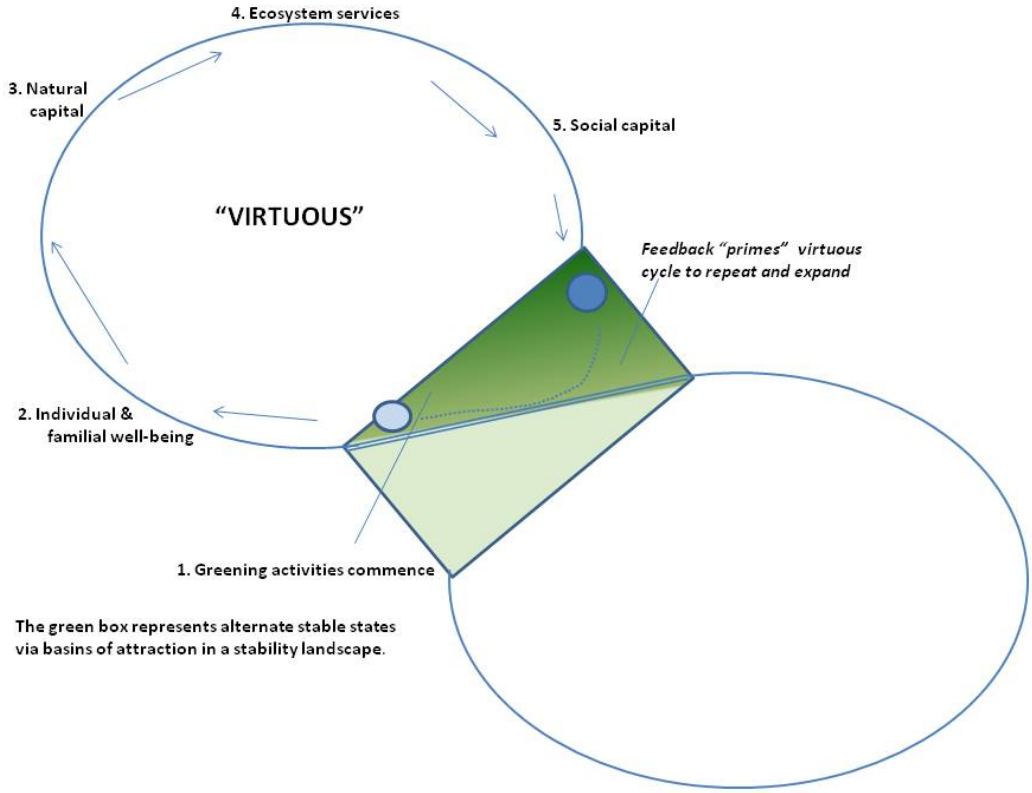


Fig 6.4. An example of a virtuous cycle. A similar version of this graphic appears in: Tidball, KG and ME Krasny (2011). Toward an ecology of environmental education and learning. *Ecosphere*, 2(2).

More specifically, virtuous and vicious cycles or feedback loops are foundational to social-ecological systems resilience thinking (Gallopin 2002; Powell, Selman et al. 2002; Matthews and Selman 2006; Selman 2006; Tidball and Krasny 2011). They represent interactions that are typically self-sustaining and reinforce one another. Thus, identifying virtuous cycles and feedback loops is important because they are the source of significant change and therefore leverage within a system, not because they are "good" or "positive" in and of themselves.

As Tidball and colleagues have argued, the operation of virtuous cycles and feedback loops is how revolutions start and local movements become national or even global (Weinstein and Tidball 2007; Tidball and Weinstein 2011). Identifying virtuous cycles and feedback loops is particularly important, then, because if a social, economic or ecological system is feeding back information about its progress to itself over time, then it will grow and advance with little help from outsiders. It is not enough to simply identify and locate virtuous cycles and feedback loops. Researchers, policy makers and managers must dig deeper still to identify not just important feedback loops themselves, but the particular *mechanisms* that enable the virtuous cycles or feedback loops to operate, whether particularly powerful, charismatic, or well-placed individuals, collective behaviors, institutional forces, or means of information transmission (Tidball and Weinstein 2011).

Given the above description of general, hypothetical virtuous cycles and their importance, what does a "real" virtuous cycle look like, and how can policy-makers and managers recognize them when they see them so that they can invest in them? We will answer both questions using the case of urban reforestation in New Orleans.

Urban Reforestation in New Orleans: Civic Ecology Practices in Virtuous Cycles

Poole (1998) invoked the term *civitas oecologie* (civic ecology) to refer to the importance of incorporating sensitivity to both the civic and natural elements of a city in building urban infrastructure. Wolf (2008, p. 308) employs the phrase civic ecology

to describe “how people in cities and communities benefit from being involved in environmental projects, how urban ecosystems benefit communities, and how to encourage conservation behavior.” In enhancing local ecosystems through such practices as community forestry, community gardening, and watershed restoration, humans also can enhance the social systems nested within larger ecosystems, a kind of resilience enhancing feedback (Tidball and Krasny 2007). Evidence of this was observed through Cornell’s Civic Ecology Lab’s activities in post-Katrina New Orleans.

Human action to restore and steward local ecosystems, and in so doing enhancing social well-being, can and often does occur under the harshest of conditions, including in cities and after disasters such as Hurricane Katrina. Tidball and Krasny (Tidball and Krasny 2007; Krasny and Tidball 2010; Tidball and Krasny 2010) use the term civic ecology to guide investigations into the systems-level and educational implications of the stewardship actions of people in heavily human influenced SES, and suggest that attention be paid not only to the outcomes of such practices for people and communities (Wolf 2008) but also to the virtuous cycles and feedback loops created when civically-oriented stewardship practices create habitat patches that provide not only social, but also ecological benefits (Elmqvist, Colding et al. 2004; Tidball and Krasny 2008).

One example of a virtuous cycle based upon civic ecology practices is seen in the reforestation activities that occurred among citizens in New Orleans after the

devastation of Hurricane Katrina in 2005. Hurricane Katrina made landfall in New Orleans, Louisiana, USA on August 29th, 2005, devastating the city leaving 1,500 people dead and tens of thousands without homes. Approximately 80% of New Orleans was flooded, with some parts under 15 feet (4.5 m) of water. Most roads and critical infrastructure were rendered inoperable. Mortality and severe structural damage was wrought upon approximately 320 million large trees throughout the Gulf Coast (Chambers, Fisher et al. 2007), many thousands of which were destroyed in New Orleans. According to Edward Macie, regional urban forester for the U.S. Forest Service's Southern Region, about 75 percent of the trees in New Orleans were lost due to the storm (Kaufman 2007). The story of New Orleans' struggle to endure weeks of inundation and devastation, and months of disorganized efforts to recover from the disaster, is relatively well-known (United States 2006; Waugh 2006; Brunsma, Overfelt et al. 2007). However, the important catalyzing virtuous cycles involving the symbolic roles of trees and the act of tree planting in post-Katrina New Orleans are less widely understood.

Hurricane Katrina's destructive force effectively disturbed and destroyed important elements that contributed to the place-ness of New Orleans (Campanella 2006), and to the individual, familial, neighborhood, and community identities associated with the place, the trees. The loss of such a large portion of the urban forest also had significant biophysical consequences, including disruption to carbon and nitrogen cycles (Chambers, Fisher et al. 2007), loss of bird habitat, and loss of urban canopy cooling functions (Sheikh 2006; Nowak and Greenfield 2012). Remembering the value of the

urban forest of New Orleans in terms of both place, and less explicitly though palpably in terms of functionality and ecosystems services, many residents immediately began to organize and rally around tree recovery, tree removal, and tree planting. Not-for-profit organizations as well as academic and extension institutions quickly recognized and responded to the emergence of tree stewardship as a form of symbolic and substantive recovery efforts for New Orleans. Parkway Partners[16], a non-profit organization whose mission is to "empower residents to improve quality of life through the preservation, maintenance and beautification of neutral grounds, green spaces, playgrounds, parks, community gardens and the urban forest in New Orleans," took the lead in education and action regarding restoration of the urban forest in New Orleans. Through their Tree Troopers planting and stewardship training program involving over 75 citizens, thousands of trees have been planted throughout New Orleans (see Figure 6.5). Parkway Partners and the Tree Troopers program trained a number of highly motivated New Orleans residents with deep interest in the importance of the urban forest, including Monique Pilié, founder of Hike for KaTREEna[17], another not-for-profit organization in New Orleans that has planted thousands of trees in addition to those planted by Parkway Partners (see Fig 6.6).

[16] http://www.parkwaypartnersnola.org/
[17] http://www.hikeforkatreena.org/

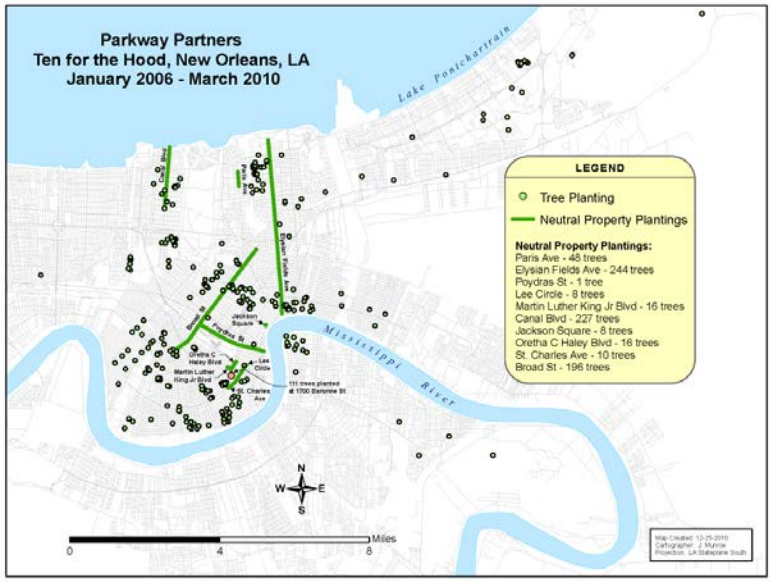


Fig. 6.5. A map depicting wide dispersal of plantings throught the New Orleans Metropolitan area immeditaley after Hurricane Katrina. Plantings depicted represent only one of many tree planting programs conducted by Parkaway Partners.

Efforts to document the extent of the urban forest canopy restored by citizen reforestation efforts using spatial analysis including GPS and other techniques have thus far been relatively disappointing, due to the size of most tree specimens used for planting and problems with resolution as well as timing and seasonality of ortho-imagery for comparison (Mornick and Tidball 2010; see also Appendix 2, this volume) However, other forms of evidence that citizen led urban reforestation is making an impact on the New Orleans SES are emerging.

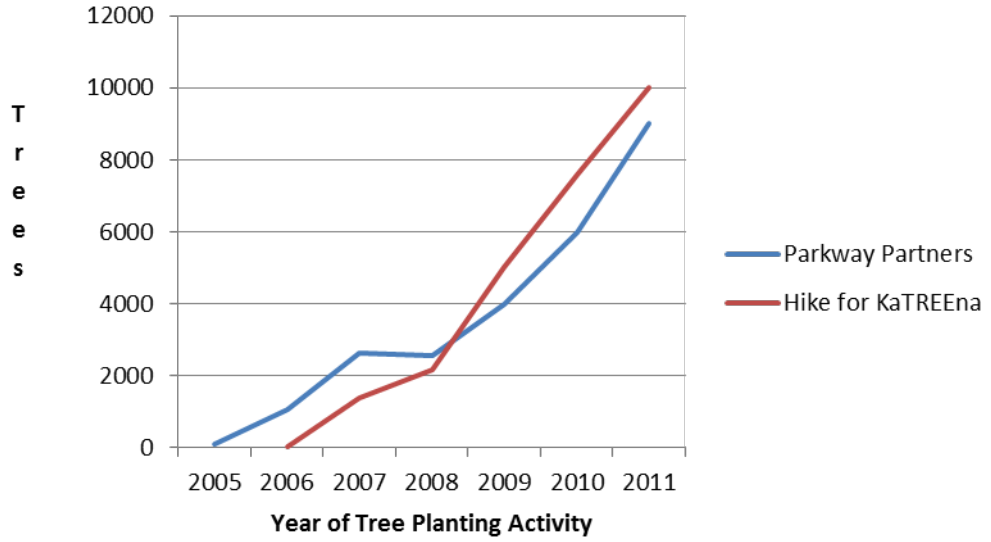


Fig 6.6. Graph depicting growth of tree planting activity in New Orleans after Hurricane Katrina as reported by leading NGOs involved in reforestation efforts.

Through extensive ethnographic research conducted by Tidball, including semi-structured interviews, participant observation, ritual and symbolic analysis, and participatory visual anthropological methods, it became clear that many New Orleans residents were eager to share stories about how trees figured in to their recovery (Tidball and Krasny 2008b; Tidball in press). Residents recounted many stories about the landscape prior to Katrina, the role that trees played in their lives, how they used trees as landmarks to find the place where their home once stood, and how the surviving trees gave them hope that they too would persevere and maintain their roots in New Orleans. Later, as recovery and rebuilding from Hurricane Katrina progressed, the emergence of a distributed community of practice (Daniel, Schwier et al. 2003) around urban reforestation was detected (Tidball, Krasny et al. 2010; Ch. 4 this volume). This urban reforestation distributed community of practice made it their

mission to reforest, or "ReLeaf"[18], New Orleans, grounded in both social and ecological motives. In short, the New Orleans residents reported that the trees they were planting would serve two kinds of purposes, practical and symbolic. The practical purposes had to do with ecosystem service provision such as basic aesthetics, shading and cooling, and stormwater management; the symbolic purposes had to do with demonstrations of individual, familial, neighborhood, and New Orleans Metropolitan area –scale resilience, recovery, rebirth, and resistance (Ch. 4 this volume).

The notion of an emergent and resilience-conferring virtuous cycle involving trees and tree planting in New Orleans became evident to Tidball in late 2007, after he attended neighborhood meetings and participated in tree planting activities where lengthy discussions ensued regarding the multiple and linked benefits of trees and tree planting in neighborhoods. A depiction of how New Orleans reforestation is theorized to be part of virtuous cycles involving local decisions and local-scale ecological processes that may contribute to large scale environmental change was later proposed (Tidball and Krasny 2008b, see Figure 5.7). In it, New Orleans citizen reforestation efforts were argued to both a.) foster social system health and resilience (drawing on social capital, civic ecology, and participatory environmental education literatures), and b.) enhance the urban forest or urban ecosystem in measurable ways (drawing on community greening, urban community forestry, and urban restoration ecology literatures). A smaller, virtuous cycle is described wherein more urban community

[18] http://www.parkwaypartnersnola.org/ReLeafNewOrleansInitiative.html

forestry leads to more social system health and resilience, which leads to more urban community forestry and so on and so on. In a larger cycle, the urban forest, newly benefited from urban community forestry activities, produces enhanced ecosystem services, both purely biophysical such as reduced urban heat, increased carbon sequestration, bird and other wildlife habitat, water filtration, storm buffering, and others, as well as aesthetic, cultural, public health related ecosystem services, resulting in reduced crime (Kuo, Bacaicoa et al. 1998; Kuo and Sullivan 2001; Branas, Cheney et al. 2011), improved air (less asthma) and water quality, increased social cohesion, increased economic indicators (Wolf 2003), and other cultural benefits (Miles, Sullivan et al. 1998). These ecosystem services contribute to and enhance social system health and resilience, which may spawn additional urban community forestry and associated positive environmental change

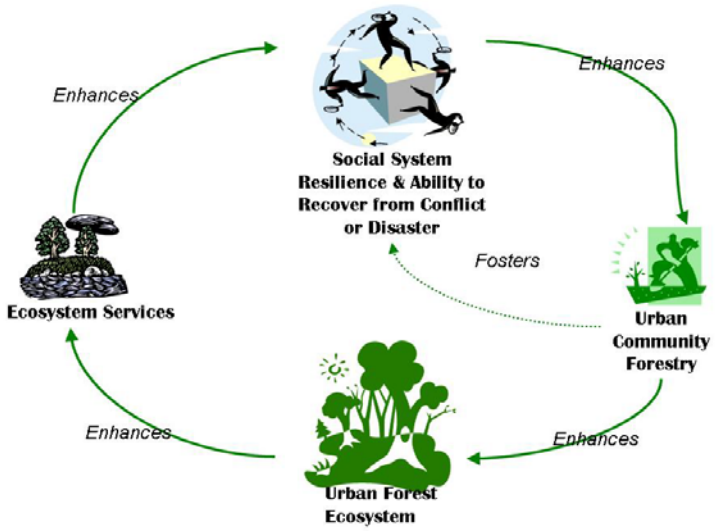


Fig 6.7. A virtuous cycle of tree planting or greening in a disturbed social-ecological system. Originally presented as: Tidball, KG & ME Krasny. 2008.

Locating Feedbacks and Virtuous Cycles- Management Implications

In her book *Advances in Urban Ecology*, Alberti (2008) reminds us that when we want to model urban ecosystems, we must "consider the feedback mechanisms that connect the natural and human systems." She says:

Interactions between ecological and human functions involve several feedback mechanisms. Within urban development, for example, real estate markets involve the feedback mechanisms of buyers and sellers adjusting their prices in reaction to the relative abundance or scarcity of real estate. Feedback mechanisms can be negative, or dampening forms that tend to stabilize systems – such as real estate markets. Feedback can also be positive, accelerating adjustments and leading to unstable conditions that change catastrophically as in the case of ecological succession or the extinction of species. The shift between these multiple states is often abrupt, and systems respond to perturbation in ways that are complex and highly nonlinear. The process becomes nonlinear as multiple agents, such as natural vegetation and urban development, interact and compete for space. The characteristic response shows strong hysteresis; that is, when an ecosystem shifts from the vegetation state to the sprawl state, it becomes highly resistant to switching back (p. 231).

The presence of feedback mechanisms akin to the aforementioned in urban systems is alluded to by Grimm et al (2000) who, while describing their work in urban Long Term Ecological Research contexts, claimed that "without understanding interactions and feedbacks between human and ecological systems, our view of ecosystem dynamics both at local and global scales will be limited—as will our ability to apply these insights to public policy and land management" (p. 573). Yli-Pelkonen and Niemela (2005) later remind us, in keeping with resilience thinking, that "biological systems, including ecological systems and social systems are open, adaptive systems, which interact with their environments" (Folke et al.1998). They go on to argue that "...the importance of feedback for adaptive systems is essential, and these systems can learn from mistakes and self-organize after feedback" (p. 1958).

According to Folke (2006) and others (Redman 1999; Lebel, Tri et al. 2002), when trade, globalization and growth in organizational structure in urban areas contributes to decision-makers becoming distant or alienated from environmental feedback, a kind of "pathology of natural resource management" (Holling and Meffe 1996) may emerge. So how do we locate feedbacks and identify virtuous cycles so that managers can avoid pathologies of natural resource management and instead reflect adaptive reorganization represented by the presence of virtuous cycles?

Social-Ecological Matrix

One method that may be useful for detecting the potential for resilience-conferring feedbacks and virtuous cycles is a recently proposed four quadrant social and ecological valuation matrix using combinations of high and low social and ecological values (Ranara, Ståhle et al. 2011). The social-ecological matrix is described as a conceptual framework and tool that complements monetary valuation by capturing non-monetary social and ecological values in human-dominated landscapes. A graphical and intuitive two-axis, four quadrant "possibility space" facilitates thinking about prevailing and desired conditions: geographical areas are identified in a region of interest; their social and ecological values ranked and categorized into the corresponding low-low, high-low, low-high and high-high value quadrants of the matrix; and the spatial occurrence/distribution of these value combinations are portrayed in a map.

The authors argue that use of the matrix in multiple contexts can enhance opportunities for greater participation in landscape design and management as well as stimulate a richer deliberation and investigation of the complex, integrated social-ecological nature of human dominated systems. Its advantage in use for detecting virtuous cycles and locating feedbacks is in its participatory design. Local residents, school children, or other user groups can be the persons engaged in the initial ranking of a given space, as opposed to only professionals and policy-makers. Local determinations of either landscapes to be protected or landscapes to be restored can be communicated in multiple media outlets and fora, contributing to a process earlier mentioned where elements of a system are feeding back information about its progress to itself over time, and then grow and advance with little help from outsiders. As discussed above, simply identifying and locating virtuous cycles and feedback loops is not enough, identifying the particular *mechanisms* that enable the virtuous cycles or feedback loops to operate is important, and in the case of the social-ecological matrix, the participatory means of information transmission and resulting civic ecology practices of protection or restoration are the mechanisms.

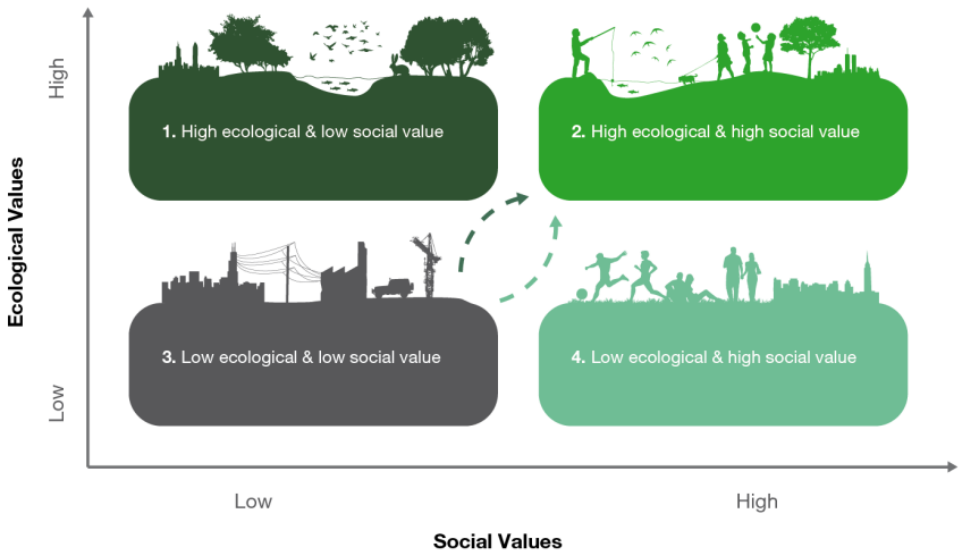


Figure 6.8, Ranara, J., A. Ståhle, A. Zetterberg, U. Mörtberg, F. Liljeros, H. Nagendra, A. Telenius, K. G. Tidball, and T. Elmqvist. 2011. Mapping of Social-Ecological Values in Stockholm: Implications for Ecosystem Services, and Urban Transition Planning. International Association of Landscape Ecologists, Europe, 2nd Symposium: Implementation of landscape ecological knowledge in European urban practice, Laufen, Germany.

Six Elements of a Virtuous Cycle

A second possibility for identifying virtuous cycles and resilience conferring feedbacks proposed here is an assessment approach that builds on the above SES Matrix, but differs from it in important ways. In the matrix above, the "sweet spot" is in the "high-high" quadrant. As such, the matrix approach seems potentially limited to only being able to accentuate landscape properties or characteristics, with an eye towards planning and restoration activities or objectives. To more precisely identify

feedbacks and virtuous cycles that confer resilience requires a different diagnostic approach, one that detects key characteristics in social-ecological processes.

Referring back to the virtuous/vicious cycle diagram (Figure 6.4), five elements comprise the feedback that primes the cycle to "repeat and expand." These five elements, we argue, are necessary variables, ingredients if you will, for social-ecological virtuous cycles. A sixth element is also required, which is implied in Figure 6.4, but not expressed explicitly. That is that there must be connectivity and inertia or momentum that can be relatively easily understood and visualized.

Table 6.1 Virtuous cycle elements derived from virtuous cycle model.

Diagram Elements from Fig. 6.4	**Derived Virtuous Cycle Elements**
1. Greening activities commence	Emergence of civic ecology practice
2. Individual & family wellbeing	CEP participation that increase self-satisfaction, reward, and well-being
3. Natural capital	CEP participation that increase the *stock* of ecosystems that yields a flow of valuable ecosystem goods or services into the future
4. Ecosystem services	CEP that result in *services* that benefit people like shade, aesthetics, and others
5. Social Capital	Services that increase interaction and a place for social engagement
6. Recurring engagement	Connectivity, inertia, and momentum

As posited above, we argue that there are six important elements that constitute a virtuous cycle that confers SES resilience. Each of these elements builds upon research spanning multiple disciplines. The six elements are further described in the paragraphs below.

Element 1- Emergent civic ecology practice

Holling and Gunderson's (2002) adaptive cycle represents a useful metaphor for how a SES changes over time, with a period of rapid growth followed by a conservation phase, eventually leading to brittleness or reduced ability to absorb shocks or disturbance. Thresholds are reached when disturbance forces the system into a new state characterized by different processes. Although initially chaotic, such drastic change and "energy release" also provide opportunities for reorganization and rebuilding. It is during this release phase, whether following war, disasters, or the collapse of political entities and institutions, that civic ecology practices often emerge and contribute to the subsequent reorganization phase (Krasny and Tidball 2012), such as community gardening in post-conflict Bosnia, the creation of Martissant Park in Port-au-Prince, or the greening of the Berlin Wall Trail (Tidball and Krasny in press).

Element 2- Civic ecology practices increase wellbeing

In addition to social-ecological memories of horticultural practices, less tangible, evolutionary memories of human's relationship to nature may come into play (Tidball 2012). Kellert and Wilson's (Wilson 1984; Kellert and Wilson 1993) notion of biophilia, i.e., "the connections that human beings subconsciously seek with the rest of life," is useful in understanding human's need for, and the benefits they derive from, being in and caring for nature. Louv's (2006) *Nature Deficit Disorder* synthesized several decades of research on the emotional, psychological, and cognitive outcomes

of time spent in nature; a much smaller body of research has addressed the benefits of active nature stewardship (e.g., Austin and Kaplan 2003).

Element 3- Civic ecology practices increase natural capital

Civic ecology practices often occur in or encompass parks, community gardens and other green infrastructure, which serve as sites for wastewater treatment, microclimate regulation, pollination, food production, education, and recreation (Bolund and Hunhammar 1999; Colding, Lundberg et al. 2006; Dearborn and Kark 2009; Barthel, Folke et al. 2010; Ernstson, Barthel et al. 2010; Niemelä, Breuste et al. 2011). Civic ecology practices (Tidball and Krasny 2007) including community tree planting in post-Katrina New Orleans (Tidball and Krasny 2008a; Tidball and Krasny 2008b; Tidball in press), natural area restoration near Cape Town (Ernstson, Leeuw et al. 2010), and oyster restoration in NYC (Kudryavtsev, Stedman et al. In press) contribute to the green infrastructure in many cities, which results in net increases in natural capital, such as such as trees, urban and suburban terrestrial ecosystems, and the atmosphere.

Element 4- Natural capital increases production of ecosystem services

Costanza and colleagues consider the general class of natural capital as essential to human welfare (Costanza, d'Arge et al. 1997), and link stocks of natural capital to provision and production of ecosystem services. Natural capital captures solar energy and behaves as an autonomous complex system, and contributes to the production of marketed economic goods and services, which are linked to human welfare. Natural

capital also produces ecological services and amenities that directly contribute to human welfare without ever passing through markets (Costanza 2000). We argue here that efforts to conserve or better yet, increase stocks of natural capital are explicitly linked, especially in already constrained urban or heavily populated landscapes, to production of ecosystem services (TEEB 2010). Quite simply, in the case of urban reforestation, increasing natural capital stocks by planting more trees to expand the urban forest results in potentially greater production of ecosystem services.

Element 5- Access to and benefits of ecosystem services increases social capital

In addition to natural capital, scholars of ecological economics and others have identified human, manufactured, and social capital as important to human well-being (Costanza, Cumberland et al. 1997; Costanza, d'Arge et al. 1997). In the domain of social capital, we inevitably must contend with the complex, controversial, and continually evolving concept of human well-being (Butler, Chambers et al. 2003; Balmford, Bennun et al. 2005; Butler and Oluoch-Kosura 2006). As Butler and colleagues argue, "even though some of the main elements of human well-being (including the feeling of security) can be considered psychological, these psychological aspects are shaped by and reflect material circumstances, including *access to adequate ecosystem services* (emphasis added)... in many cases, an insufficiency or maldistribution of ecosystem services contributes to a sense of insecurity, and often, to poor social relations" (Butler and Oluoch-Kosura 2006). We understand such insecurities and poor social relations in social capital terms, and find

the linkage easily discernible between access and benefits of ecosystem services and social capital.

Element 6- Connectivity, inertia, and momentum- is it a cycle?

This element entails determining if a perceived effect or change in a social-ecological system is an isolated incident, or if it is "catching on" and spreading throughout a population. Explanations for dissemination, adoption, and adaptation of ideas and practices come from many disciplines and fields including innovation / adoption (Rogers 1995) social network analysis (Bodin and Crona 2009), social innovations (Moore and Westley 2011) and policy entrepreneurs (Maguire, Hardy et al. 2004). Specific to systems thinking and feedbacks are descriptions of connectivity, inertia and momentum from expansive cycles (cf. Engeström 1987; Barab and Roth 2006; Chawla 2008), swarm theory or swarm intelligence (cf. Bonabeau, Dorigo et al. 1999; Karaboga and Akay 2009), collective action (Olson 1965/1971; Udehn 1993), social movements theory (Jamison, Eyerman et al. 1989; Melucci 1992), and so on. A virtuous cycle might demonstrate connectivity, inertia, or momentum in any of the above ways, or in ways not yet uncovered.

A Diagnostic Tool for Detecting and Cultivating Virtuous Cycles?

Given the above description of a diagnostic approach, how might planners, practitioners, and scholars actually go about detecting and then cultivating desirable virtuous cycles? Here we propose a rudimentary beginning to such important

diagnostic tasks, and in so doing initiate what we hope will be an ongoing, collaborative, iterative construction of a tool for evaluating whether or not a given system possesses or shows potential to possess emergent civic ecology practices that catalyze or initiate resilience conferring virtuous cycles. One might imagine using the chart below as a diagnostic tool to begin an assessment of a SES wherein civic ecology practices might possibly be expected to contribute to the emergence of virtuous cycles. The following paragraphs walk the reader through an illustrative exercise to simulate detecting and cultivating virtuous cycles using New Orleans post-Katrina (or other high-profile cases) as an example.

Table 6.2. A diagnostic tool for detecting virtuous cycles via civic ecology practices in social-ecological systems.

Diagnostic Question	**Yes, no, don't know?**	**Examples or description**
Does the system possess or show potential to possess *emergent civic ecology practice (CEP)*?		
Is there evidence of CEP *increasing individual or family wellbeing?*		
Is there evidence of CEP *increasing stock of ecosystem goods into the future?*		
Is there evidence of CEP *increasing ecosystem services?*		
Is there evidence of CEP increasing social interaction and engagement?		
Are there examples of connectivity, inertia and momentum generated through CEP?		

As above, the first step is to locate the emergence or self-organizing element: does the system possess or show potential to possess emergent civic ecology practice? In the case of post-Katrina New Orleans, emergence presented through city residents who organized around social-ecological memories (Barthel, Folke et al. 2010; Tidball, Krasny et al. 2010; Barthel, Parker et al. in press) involving the importance of trees to identity and sense-of-place, and engaged in civic environmental stewardship practices to deal with grief as well as to counter narratives about the failure of New Orleans as a city and predictions of its demise (Tidball in press). In New York City, after 9/11 citizens similarly engaged in self-organized greening activities to memorialize those lost to the terrorist attacks, and to demonstrate solidarity in their time of grieving (Tidball, Krasny et al. 2010). After a 2011 tornado destroyed over 2000 buildings in Joplin, Missouri and took the lives of 160 town residents, civic ecology practices began to emerge almost immediately as townspeople created Facebook pages and used other social media to organize themselves to plant trees and use tree memorialization as an immediate salve to their wounds. And in Detroit and other "rust belt" great lakes cities such as Chicago and Cleveland (Hansen 2008), virtuous cycles of self-organized greening activity begun in the aftermath of the devastating Dutch Elm disease outbreaks in the Midwest have continued to repeat and expand, and can now be seen to be powerful movements in opposition to erosion of their respective cities' stature (cf. Chicago Wilderness[19] or Greening of Detroit[20]). Many other examples from the US and abroad illustrate the emergence or self-organizing first element. These

[19] http://www.chicagowilderness.org/
[20] http://greeningofdetroit.com/

examples shed light upon how the system possesses or shows potential to possess emergent civic environmental stewardship practices.

After detecting an emergent, self-organizing civic environmental stewardship process within a system, the second step is defined via concepts of individual and family well-being; does participation in civic ecology practice increase feelings of personal self-satisfaction, reward, and well-being? Referring back to New Orleans, Tidball found that resident involvement in the self-organizing and expanding community of practice emerging around reforestation of the city after hurricane Katrina contributed to increased stocks of social capital, and of individual and family-level safety, security, and well-being (Tidball in press). Similarly, in Galveston, Texas, which suffered a devastating hurricane in September of 2008, greening advocates worked towards rebuilding "avenues of majestic trees of the future interspersed with the art forms of the lost trees in the shapes of sculptured angels, birds, dogs, tin men, mermaids and geishas.[21]" These kinds of emergent re-greening and recovery efforts are reported to significantly enhance individual and family well-being (Campbell and Wiesen 2009).

After determining whether or not participation in civic ecology practice increases feelings of personal self-satisfaction, reward, and well-being in the particular system of interest, the third step is to ascertain if there is evidence of civic ecology practices that measurably increase the stock of ecosystem goods into the future. In New Orleans after significant damage to the urban tree canopy as a result of Hurricane Katrina,

[21] http://theislandermagazine.com/?p=2441

civic ecology participants engaged in large scale tree planting (see Figure 6.6) that increased the stock of ecosystem goods the trees and urban forest represent. So a policy maker using the diagnostic tool (see Table 6.2, above) above would easily be able to answer yes in the second column in this case, and then describe the increase in stock of ecosystem goods.

Similar to step three above, the fourth step is to ascertain if there is evidence of civic ecology practices increasing quality and/or quantity of ecosystem services. Presumably, if ecosystem goods are being produced by civic ecology practices, then it is likely ecosystem services are being produced as well. However, it is important to distinguish between the two, and to be specific about the particular ecosystem services being produced, so that the virtuous cycle diagram that results accurately reflects what is occurring in the system of interest. In New Orleans, there were a number of ecosystem services attributed to increased stocks of ecosystem goods derived from reforestation activities; aesthetic, provisioning, and regulating. One can imagine multiple possible iterations of virtuous cycles being diagramed specifically addressing individual ecosystem services and implications of increases in their quantity or quality.

Step five requires the evaluator to link steps 1-4 by inquiring as to evidence of civic ecology practices increasing social interaction and engagement. Though, as discussed above, one might potentially identify multiple possible iterations of virtuous cycles being diagramed specifically addressing individual ecosystem services, some will be

more obviously related to social interaction and engagement then others. Though more trees in New Orleans meant better stormwater retention, that service was not mentioned as important to social interaction and engagement, where beautification and restoring a sense of place were mentioned repeatedly as ecosystem services that could easily be seen as linked to social interaction and engagement via tree planting parties and events, tree planting and tree care training sessions, and so on.

The sixth and final step is likely the most idiosyncratic and context-specific, and therefore most challenging. The challenge is to discover and document examples of connectivity, inertia and momentum generated through civic ecology practices. In New Orleans, as more and more residents felt the positive morale in their neighborhoods increasing as a result of the virtuous cycle associated with the civic ecology practice of reforestation of the city, they began to share their stories with others, who would then decide that they wanted to be involved. News media then began to report on these "feel good" stories, which became more and more numerous as time went on, priming the cycle to expand and repeat anew. Tree planting then shifted from small-scale neighborhood recovery and morale boosting, to a wide scale phenomena or movement promulgating a hopeful "rebirth" counter-discourse to the stories of New Orleans as a so-called "resilience failure" (Westrum 2006).

Conclusions

We began this contribution by describing New Orleans and the importance its residents placed upon trees in terms of their symbolic significance and their contribution to a sense of place. We described briefly how residents returning to New Orleans after the 2005 hurricane recalled and acted upon relationships between individuals or communities and trees, especially in symbolic terms as important components of individual or community recovery and resilience. We presented a review of feedbacks and virtuous cycles catalyzed via social-ecological restoration with a focus on highlighting their importance to SES resilience, and offered a handful of conceptualized and diagramed virtuous cycles.

Of greatest use in terms of this contribution, we hope, is the conceptualization of the six elements of a virtuous cycle and the possibility for an assessment approach or diagnostic tool for detecting, locating, and if possible cultivating virtuous cycles and resilience conferring feedbacks. These concepts are derived from the first author's field work in a single limited case in New Orleans. Our aim is to test these ideas in multiple additional real-world scenarios to determine if in fact virtuous cycles are similar in terms of the six elements described, and whether or not a diagnostic approach for detecting them is feasible and useful. Though we are optimistic that both the conceptualization of the six elements and the resulting diagnostic approach offer much promise in managing for resilience, especially in disturbed systems, we recognize the limitations of our study and the need for additional research.

In conclusion, we have suggested that symbolic relationships with trees that result in beneficial human activities such as widespread citizen led reforestation projects catalyze social-biological *feedbacks* and set in motion *virtuous cycles* in perturbed social-ecological systems (SES) that confer resilience. Cycles in systems start by some action that pushes a recurring series of steps and interactions. Hurricane Katrina represented a threshold where the potential transition into a vicious cycle that emphasized degradation of the environment was possible. We can think of this as an undesirable basin of attraction as depicted in Figure 6.3. However, investment in tree planting moved the threshold system to start the transition to a virtuous cycle that reversed orientation on human losses and emphasized rebuilding and rebirth of the community and the social-ecological system. Two main challenges for wide-spread application of this finding are, first, to better understand the process involved in breaking one cycle and starting another, and second, to learn how to influence or encourage a system at a threshold to move to desirable basins of attractions rather than undesirable ones, and then reinforce the virtuous cycle and keep it going. The New Orleans recovery suggests this point with initial investment and human interactions that were positive, rewarding, and reinforcing, leading to important social-ecological feedbacks system wide.

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CHAPTER 7

CONCLUSIONS- IMPLICATIONS AND APPLICATIONS

Introduction

A growing network of social and ecological scientists argue that change is to be expected and planned for, and that identifying *sources* of resilience in the face of change is crucial to the long-term well-being of humans, their communities, and the local environment. Yet, as has been pointed out in this dissertation, several gaps in the resilience literature persist, including (1) a lack of studies focused on cultural systems (Wright and Masten 2005), (2) relatively few studies that explicitly re-embed humans in ecosystems, and (3) a need for more studies that integrate the theory and science of individual human resilience with broader ecological systems theory and research exemplified by social-ecological systems (SES) resilience scholarship (Masten and Obradovic 2008). This dissertation has attempted to address these gaps by asking two fundamental questions.

First, it asks “Why do humans turn to greening in the wake of conflict and disaster?” This question invites us as humans to revisit our relationship with the rest of nature, and to ask ourselves what we may learn from ourselves, given our behaviors in urgent or dire circumstances. Second, this dissertation asks “Of what use might greening in human vulnerability and security contexts be in managing social-ecological systems for resilience?” This question alludes to application, in planning and policy making

fields, in natural resource management, and in fields of disaster preparedness, mitigation, and recovery. Both questions belie a desire to conceptualize human systems as nested within ecological systems, and therefore human resilience as nested within ecological resilience, especially in disaster resilience contexts (Gunderson 2010). The answers to these questions seem to be timely given continuing worries about conflict over access to resources, climate change, and overpopulation and the red zones that will inevitably emerge. The ways in which we as humans reorganize, learn, recover and demonstrate resilience through remembering and operationalizing the value of our relationships with elements of our shared ecologies in the direst of circumstances such as disaster and war hold clues to how we might increase human resilience to new surprises, while contributing sources of social-ecological resilience to ecosystems.

In this dissertation I have analyzed the phenomena of greening in the red zone (Tidball and Krasny in press) from ecological anthropological perspectives (via symbols, rituals, and sense of place) and from social-ecological systems resilience perspectives (via identifying sources of social-ecological resilience, detecting virtuous cycles and resilience conferring feedback), with post-Katrina New Orleans as my primary case study and field site. I have employed an integrated systems theory and critical realist epistemology and methodology to pursue a retroductive logic which asked “if these were the observations, then what could the model and theory have been?” As such, I created models that featured mechanisms in such a way that, if they were to exist and act in the postulated way, they would provide an explanation for the phenomena being

examined. Of particular interest were tree symbols, tree planting rituals, and the relationship between these social-ecological symbols and rituals and the recovery or reinterpretation of sense of place, especially in terms of resilience conferring feedbacks and virtuous cycles.

Findings and Contributions

A number of useful findings have resulted from this work. First and foremost, that there is indeed a significant portion of human society that turns to greening in red zones. There appears to be a "greening in the red zone process or cycle" that contains fundamental key sequential components, but that likely is nuanced on a case-by-case basis reflecting landscape, disturbance intensity, and other factors. This is important for a number of reasons. From the standpoint of philosophical arguments regarding human exceptionalism and exemptionalism, this finding is an important counter point. It is instructive that in a disaster, for example, humans can be seen to experience an important lesson twice. First, a lack of exemption from the force or impacts of a major disaster, second, an affirmation of a dependence upon nature for healing, health, and well-being. In other words not only are we not independent from ecosystems, we are perhaps more dependent than we are currently aware. The upshot is a sudden remembering of how dependent upon the environment we are as a species for our security and sustenance. This is a much needed paradigm, one that is in seemingly short supply in natural resource policy, management, economics, and related fields.

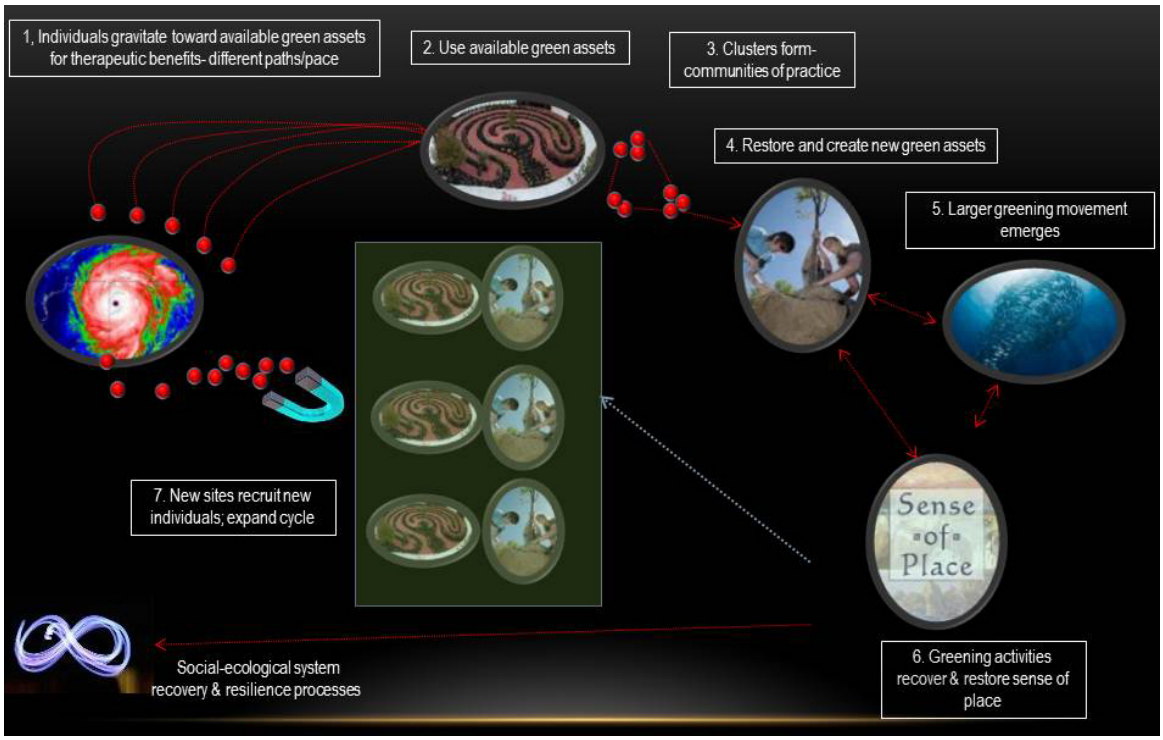

Figure 7.1. A depiction of a "Greening in the Red Zone" process or cycle

A second set of findings or contributions of this dissertation is 1) the identification and description of social-ecological memory and environmental stewardship as a source of social-ecological resilience, and 2) how tree symbols and rituals (and by extension potentially other social-ecological symbols) are remembered, reconstituted, and reproduced, and come to represent "tangible evidence of social mechanisms behind social-ecological practices that deal with disturbance and maintain system resilience" (Berkes and Folke 1998, p. 21). I have proposed and explored the following hypothesis: civic ecology practices, including urban community forestry, community gardening, and other self-organized forms of stewardship of green spaces in cities, are manifestations of how memories of the role of greening in healing can be instrumentalized through social learning to foster SES resilience following crisis and

disaster. Through working through this hypothesis, the dissertation proposes that civic ecology communities of practice within and across urban systems help to leverage these memories into effective practices, and that these communities of practice serve as urban iterations of the collaborative and adaptive management practices that play a role in SES resilience in more rural settings. A *memorialization mechanism* is proposed that leads to feedbacks critical to SES resilience. The process begins immediately after a crisis, when a spontaneous and collective memorialization of lost ones through gardening and tree planting ensues, following which a community of practice emerges to act upon and apply these memories to social learning about greening practices. This in turn may lead to new kinds of learning, including about collective efficacy and ecosystem services production, through a kind of feedback between remembering, learning, and enhancing individual, social, and environmental well-being. This process, in the case of greening in cities, may confer SES resilience, through contributing to psychological–social resistance and resilience and to ecosystem goods and services production.

A third set of contributions are compatible biological and cultural explanations for greening behaviors in human vulnerability and security contexts. Building upon contemporary work on principles of biological attraction as well as earlier work on biophilia while synthesizing literatures on restorative environments, community-based ecological restoration, and both community and social-ecological disaster resilience, this dissertation suggests that when humans faced with a disaster, as individuals and as communities and populations, seek engagement with nature to further their efforts to

summon and demonstrate resilience in the face of a crisis, they exemplify an urgent biophilia. This urgent biophilia represents an important set of human-nature interactions in SES characterized by hazard, disaster, or vulnerability, often appearing in the "backloop" of the adaptive cycle (Holling and Gunderson 2002). The relationships that human-nature interactions have to other components within interdependent systems at many different scales, may be one critical source of resilience in disaster and related contexts. In other words, the affinity we humans have for the rest of nature, the process of remembering that attraction, and the urge to express it through creation of restorative environments, which may also restore or increase ecological function, may confer resilience across multiple scales. In making this argument, this dissertation also represents a novel contribution to further theorizing alternatives to anthropocentric understandings of human-nature relations, and strongly makes the case for humans as part of, not separate from, ecosystems.

A fourth set of contributions lies in theorizing and defining social-ecological symbols and rituals in the context of social-ecological system resilience. This contribution builds on the seminal work of Berkes, Folke and colleagues (Berkes and Folke 1998; Berkes, Colding et al. 2003), and puts forward a special category of symbols, *social-ecological symbols*, which are related to the concept "nested ecologies" (Wimberley 2009) and are a natural outgrowth of social-ecological or integrated "humans-in-nature" systems (Berkes and Folke 1998). Environmental or ecological symbols (Appleyard 1979; Kroll-Smith and Couch 1993), a subset of symbols generally speaking, use biophysical elements in nature to represent an idea. This dissertation

breaks ground in defining a social-ecological symbol as a symbol or "storage unit" containing integrated social and ecological meanings, and also, more importantly, social and ecological interactions. Tree planting events or activities are social-ecological symbols. There is an ecological entity, trees, and a social activity, planting trees, which together communicate an idea. Social-ecological symbols, such as communities planting trees after their city is destroyed by a hurricane, can then, in the aggregate, be thought of as social-ecological rituals, storehouses of meaningful social-ecological symbols by which interrelated social and ecological information is revealed and regarded as authoritative, and is thought of as dealing with the crucial values of the community. These social-ecological symbols and social-ecological rituals can then be seen as *sources* of resilience and catalytic in the aforementioned resilient systems that appear to have learned to recognize feedback, and therefore show promise to act as "*mechanisms* by which information from the environment can be received, processed, and interpreted" (Berkes and Folke 1998, p. 21, emphasis added).

A fifth contribution of this work is the conceptualization of positive dependency. In this dissertation an argument is put forward that purely-deficit based perspectives regarding urban SES and the human populations within them represent barriers to these systems' ability to move from undesirable system states into more desirable, sustainable ones. A characterization of issues such as individual ecological identity, human exemptionalism, anthropocentrism, and resource dependence is offered, in order to better examine notions found in the resource dependency literature, such as the roots of ideas about dependency. This literature is used as a springboard into the

possibilities of an antipodal notion of resource dependency that may be applicable in urban contexts, which I have named positive dependency.

Positive dependency as a concept allows us to escape the misguided conclusions potentially drawn by resource dependence arguments that the more that humans depend on natural resources, especially for tangible needs, the more those humans become vulnerable, the more their resilience is compromised. While attempting to recover or reconcile our relationship with nature, we may not need the contradictory message that "the less we are forced to depend upon nature, the better off we are" rattling around our heads. Rather, we can benefit by contributing to the evolution of resource dependency thinking to include the at once simple yet profound idea that "the more we acknowledge our dependence on nature, especially in urban contexts, the more resilient we can be."

Two possible sources of positive dependency in urban SES are suggested, urgent biophilia and restorative topophilia. An important conclusion is the recognition of positive dependency as a precursor to the development of a heightened sense of ecological self and sense of ecological place in urban SES. This dissertation has provided suggestions for further research into civic ecology practices that may enhance positive dependency on and investment in ecological assets that contribute to positive ecological senses of self and place, and into the relationship of these processes to resilience in urban systems.

Finally, reflecting the above findings, this dissertation proposes that within this "greening in the red zone process" as mentioned as a first finding above, there are at least five important mechanisms that explain how the system functions from one sequential frame to the next (Urgent Biophilia, Restorative Topophilia, Memorialization, Symbol & Ritualization, and Expansive Virtuous Cycles). Figure 7.2 below models these mechanisms in terms of the greening in the red zone cycle. It is acknowledged that these proposed mechanisms will need further research.

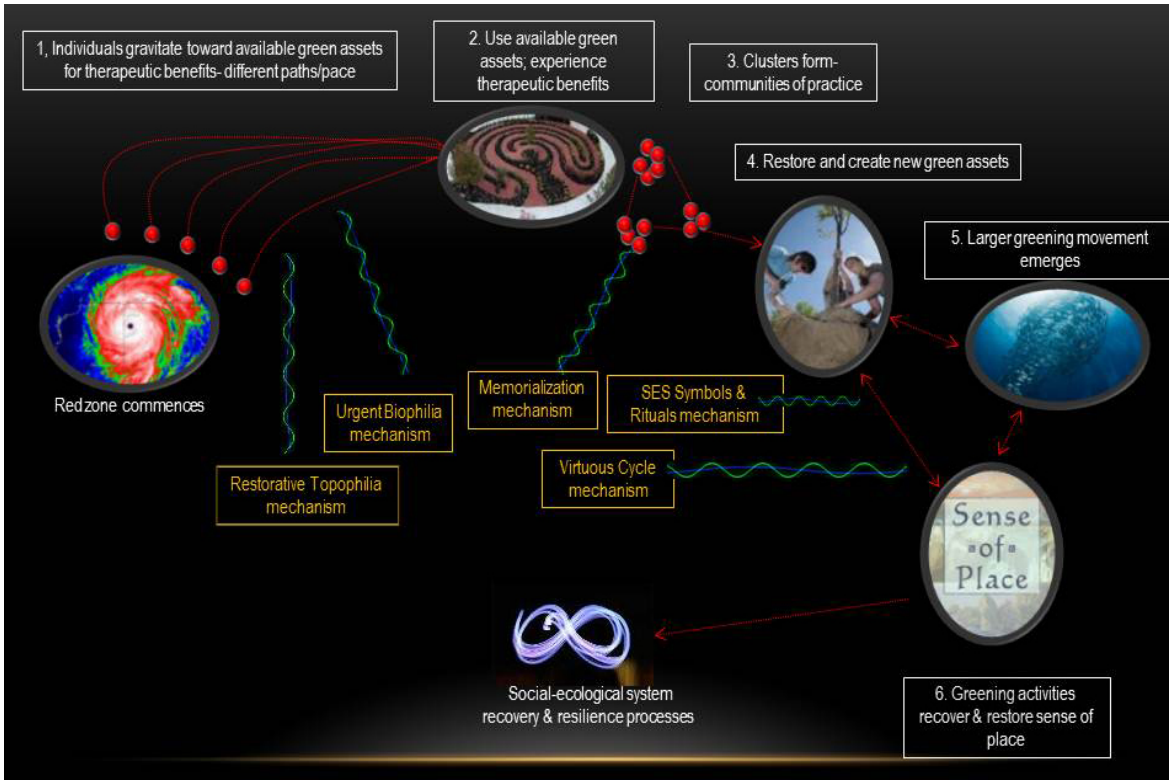

Figure 7.2. A depiction of "Greening in the Red Zone" process or cycle, including proposed mechanisms.

In short, this dissertation has addressed a role and source of environmental stewardship, social-ecological memory, and resilience in disaster contexts (***Paper I***). It has explored the possibilities of multiple explanations for why humans would engage

in greening activities from both an evolutionary biological perspective (***Paper II***) and from eco-cultural and symbolic perspectives (***Paper III***), and has attempted to account for these sources in feedbacks and virtuous cycles that confer additional resilience to disturbed social-ecological systems (***Paper IV and V***). This dissertation has situated inquiry into the above areas in a specific case, that of Post-Katrina New Orleans (***Paper I, III, V***). But above all, it has not only explored the role of greening in red zones and associated social and ecological mechanisms and feedbacks, it suggests greater utilization, application, and generalization of greening in red zones by governments and institutions called upon to respond to disaster or conflict contexts (***Paper I, II, III, IV, V***). In so doing, it invites the reader to ponder the implication of frequent human impulses to reconnect with living systems when confronted with major upheaval, and to consider the importance of "remembering our way back" to biological realities and ecological identities for human society as we endeavor to envision vibrant, verdant, resilient futures for forthcoming generations of human members of the biosphere in the 21st century.

Conclusion

In conclusion, this dissertation as a whole argues that the constellation of social-ecological memories, social-ecological symbols and rituals, the resulting relationships between human actors and other system components, and feedbacks and cycles catalyzed by relationships among trees, forests and humans, all contribute to system memory, or processes involved in "regeneration and renewal that connect that system's present to its past" (Gunderson, 2002, p. 264). When a system "remembers"

system properties, such as human-nature interactions like greening in the red zone mechanisms that produce, restore and enhance mutually beneficial outcomes for biophysical and psychosocial elements of the system, and those system memories are subsequently reified through social-ecological symbols and rituals, a unique possibility for social-ecological system resilience is introduced. Human-nature interactions, particularly those of a class of human-nature interactions called civic ecology practices such as community forestry activities (e.g. tree planting), enhance the ability of people in red zones to organize, learn, and act to increase their capacity to withstand, and even grow from, rapid change and uncertainty through nurturing cultural and ecological diversity, through creating opportunities for civic participation or self-organization, and through fostering new and novel ways of learning from different types of knowledge.

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APPENDIX 1

DESCRIPTION OF ONTOLOGY, EPISTEMOLOGY, METHODOLOGY AND MIXED METHODS MODEL EMPLOYED FOR THE DISSERTATION

Ontology

The exercise of discovering one's ontological proclivities is not only a necessary precursor to understanding what to research and how to go about researching it; it is also a rite of passage (Arnold Van Gennep 1960) in and of itself. I undertook this rite of passage in phases, having a sense of where I stood amongst the choices, but exploring further to be thorough and as openly reflective as possible. I first endeavored to understand my ontological stance regarding "reality" itself, and the universality of reality (or realities), narrowing the possible choices to nominalism, conceptualism, and realism. I understood nominalism to be the most restrictive of three, allowing no universals- and no nexus of predication other than what occurs in language (Brink and Rewitzky 2002). Conceptualism, my studies indicated, allowed for the existence of *some* universals, called concepts, which are thought to underlie predication in thought and language. Concepts, however, cannot exist independently of the socio-biologically based capacity humans have for thought and language (Sawyer 2006). In the end it was realism that was most resonant, the idea that universals underlie prediction in reality, and that these universals are assumed to exist independently of the human capacity for thought and language (Harré 1986). Figures

A1.1 and A2.2 succinctly lay out the fundamental assumptions that comprise my ontological perspective or philosophy.

Figure A1.1. Ontological assumptions with a critical realist orientation.

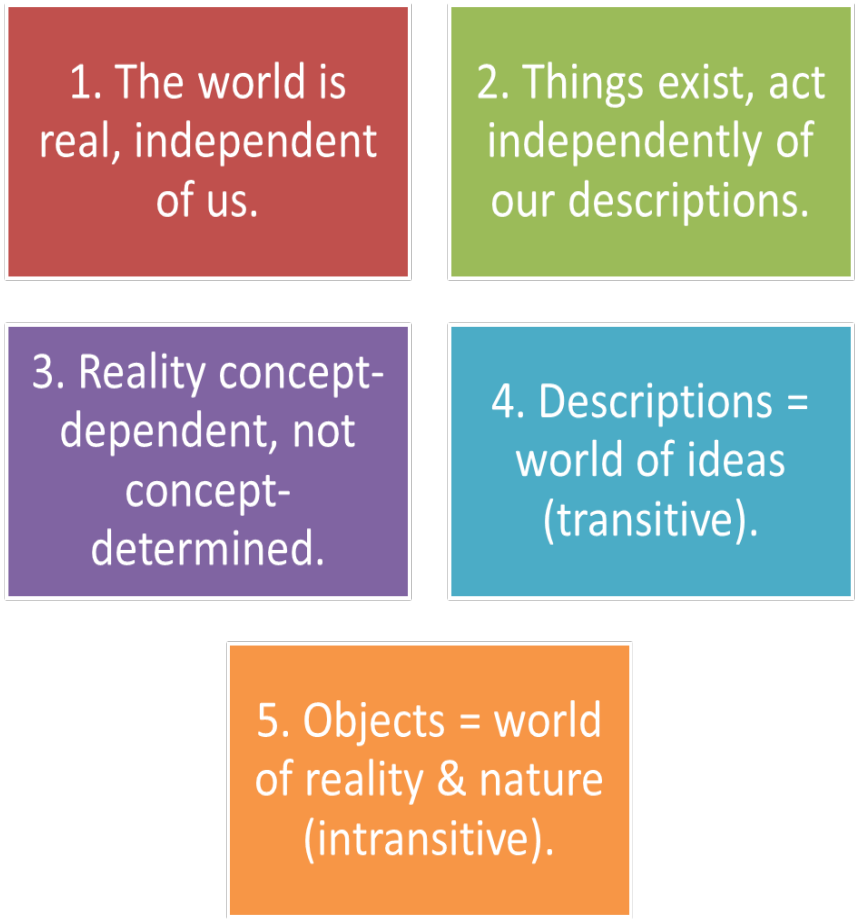
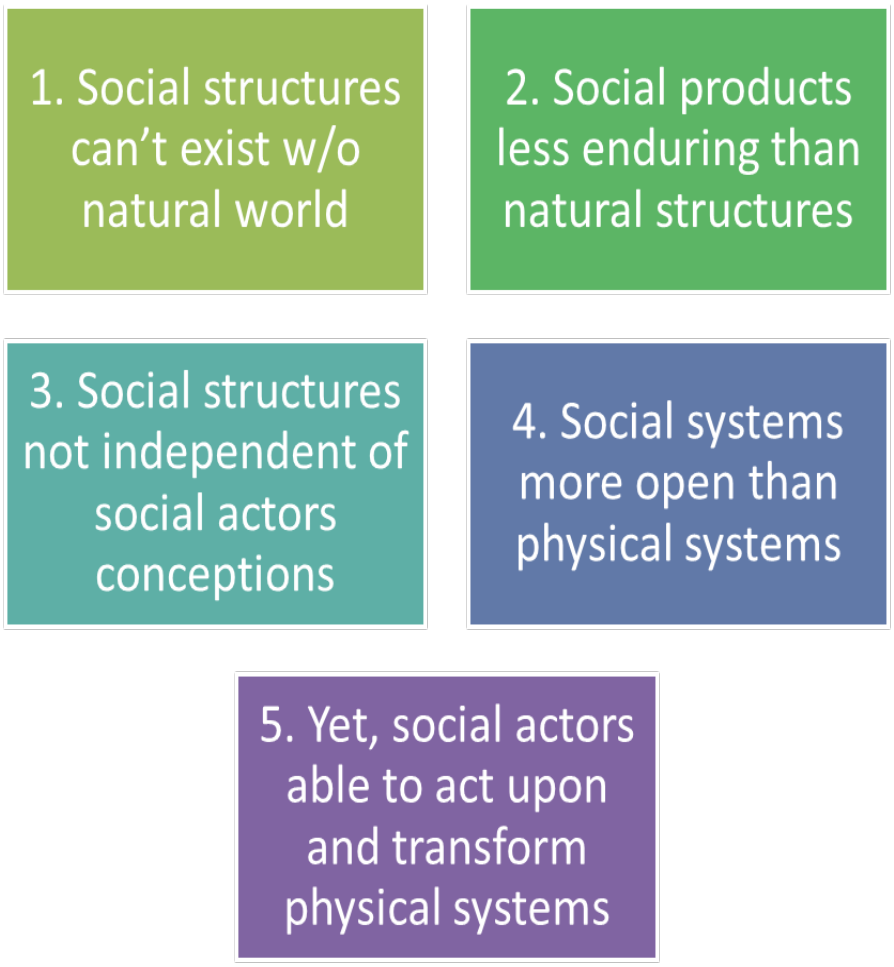


Figure A1.2. Realist nuances among "natural" and social worlds.

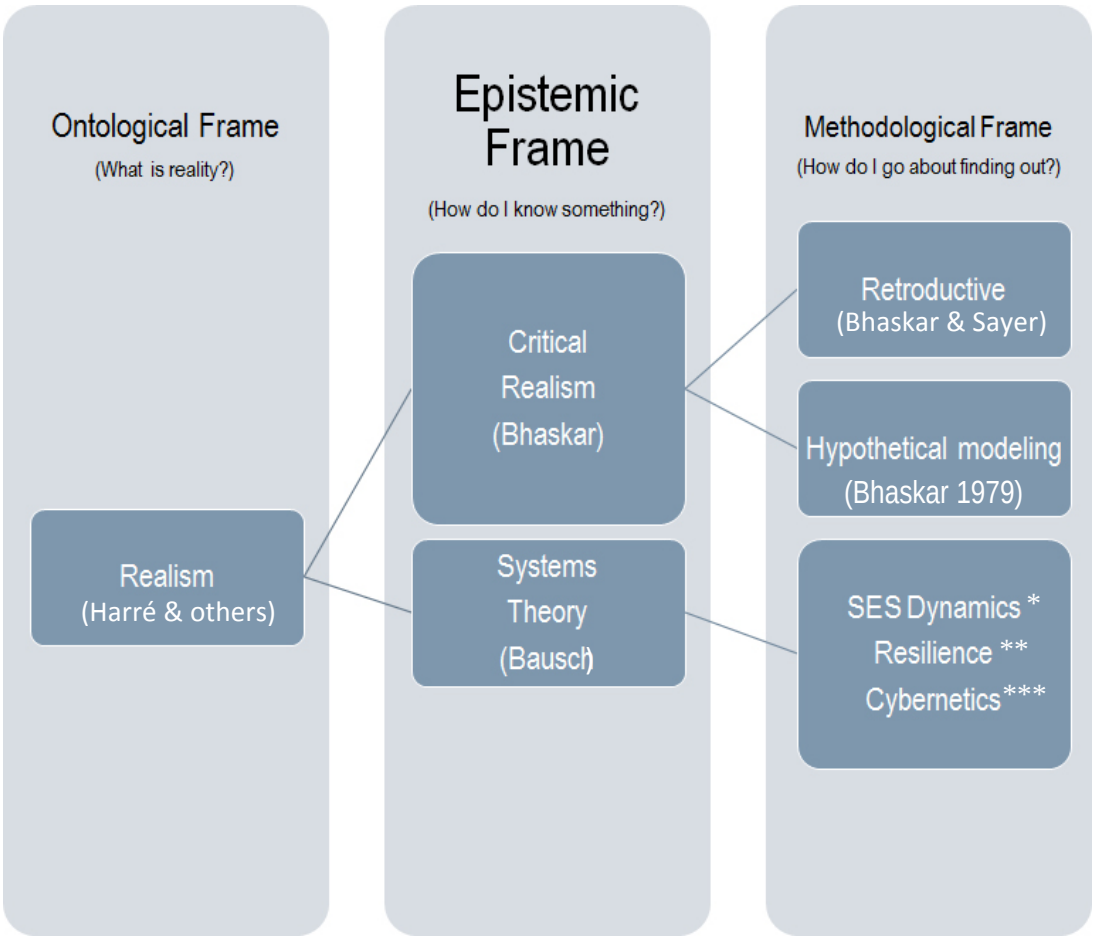


Having my ontology of realty well enough settled, I moved on to exploring an ontology of research. Here again, three paradigms emerged; positivist, interpretivist/constructivist, and realist. The field of philosophy has no shortage of divergent opinions regarding these and other research philosophies or ontologies, and I won't go into great detail here (but see Blaikie 1993 for excellent overviews and

literature reviews). I experienced a level of discomfort with the positivist stance that data derived from sensory experience, and the mathematical and logical treatments of such data, are together the *sole* source of all authentic knowledge. I concluded that this must mean positivists reject introspective and intuitional approaches to gaining knowledge. On the other hand, purely interpretivist or constructivist approaches struck me as not sufficiently *realistic*. While rejecting purely constructivist approaches, I felt an urge to escape positivism's pattern model of explanation, that explanation can only be achieved by establishing regularities or constant conjunctions (Blaikie 2004). For me, and for the founders of critical realism, establishing these regularities is only the beginning of the process of inquiry. What is then required is to locate the structure or mechanisms that have *produced* the regularity (Berkes and Folke 1998; Blaikie 2004). These structures and mechanisms, as Blaikie (Ibid.) argues, are the tendencies of things to act in a particular way.

Settling once again as a realist, but searching for a more pragmatic approach, I am sympathetic to the arguments of Harré (1961) and Bhaskar (1979) who endeavored to overcome the deficiencies of the logic of induction and deduction for use in offering causal explanations, in favor of retroduction (Blaikie 2004). Retroduction, explained in more detail below, deals with the idea of "going back from, below, or behind observed patterns or regularities to discover what produces them" (Ibid.).

Figure A1.3. Ontology, epistemology, and methodology for the dissertation.



* (Walker, Holling et al. 2004; Folke 2006)
** (Holling 1973; Holling 1986; Holling 1996)
*** (Bateson 1979)

Epistemic Frame

Critical Realism

The epistemic frame with which I approach this work has two components, both rooted in a realist ontology: critical realism (Bhaskar 1978; Bhaskar 1979) and systems theory (Bausch 2001). Because a critical realist's conception of *causality* differs slightly from the positivist's in that it emphasizes tendencies of things to occur, as opposed to regular patterns of events, a critical realist conceives of science as an empirically-based, rational and objective inquiry, the purpose of which is to provide a true *explanatory* and *predictive knowledge* of society (Keat and Urry 1980). The critical realist is of the opinion that our perceptions are shaped by our theoretical resources and investigative interests (McEvoy and Richards 2006). Our knowledge of the world is always mediated by the discourses available to us, but we can get empirical feedback from those aspects of the world that are accessible (Sayer 2004).

Systems theory

The systems theory orientation integrates information systems, cybernetics, communication theory, organizational design and management, and evolutionary theories into a coherent vision of the world that does not focus so much on the way things exist in our world, but instead, on how dynamic and evolutionary processes work (Bateson 1972; Bateson 1979; Bausch 2001). This epistemological orientation refers specifically to self-regulating systems, systems that are self-correcting through

feedback. Self-regulating systems are found in nature, including the physiological systems of our body, in local and global ecosystems including climate systems, and in human learning processes (cf. Odum, Capra, Holling, etc.).

Methodological Frame

Retroductive

Moving from epistemology to methodology, one can think of retroduction as the logic that underpins the epistemological frame of critical realism, and it involves moving from the level of observations and lived experience to postulate about the underlying structures and mechanisms that account for the phenomena involved (Mingers 2003). Retroduction has been described as “a mode of analysis in which events are studied with respect to what may have, must have, or could have caused them… in short it means asking why events have happened in the way they did” (Olsen and Morgan 2004). In other words, and in contrast with deductive logic that asks, "If this is the model, then what will the observations be?", retroductive logic — which uses deduction supplemented by imaginative creativity — asks a reversed question in the past tense, "These were the observations, so what could the model (and theory) have been?" The essence of retroductive inference is doing thought-experiments, over and over, each time "trying out" a different or revised model that is being proposed (by selection or invention) with the goal of producing predictions (i.e. theory-based deductions) that match the known observations. Basically, the goal is to find a theory that, if true, would explain what has been observed. Ginzburg (1990) traces the

emergence of retroductive reasoning back to the needs of hunters. To track down their prey, hunters needed the ability to look for clues such as broken branches, hoof marks, tufts of hair and odors, and then ask themselves, “What does it indicate?” When they encountered unusual clues such as new scents they were then able to speculate what the cause of the scent might be (McEvoy and Richards 2006). Retroductive reasoning takes place in similar ways in the context of scientific research, as mechanisms are postulated to account for observed phenomena via analogy, metaphor and model building (Lawson 1989). Examples from biophysical science include concepts such as atoms, viruses, and genes, all of which were hypothetical entities and models for quite some time before technologies were advanced enough to observe them (McGregor 2007).

Hypothetical Modeling

The critical realist builds theories by referring to models (Keat and Urry 1980) to describe the essence of causal mechanisms and structures. Models, in the critical realist’s viewpoint, are vehicles carrying pictures of generative and productive mechanisms (Stockman 1983) and they play a key role in scientific inquiry. Models are built of mechanisms in such a way that, if they were to exist and act in the postulated way, they would explain the phenomenon being examined. From the critical realist perspective, underlying mechanisms can *only* be known by constructing ideas about them; and models reveal the underlying mechanisms of reality.

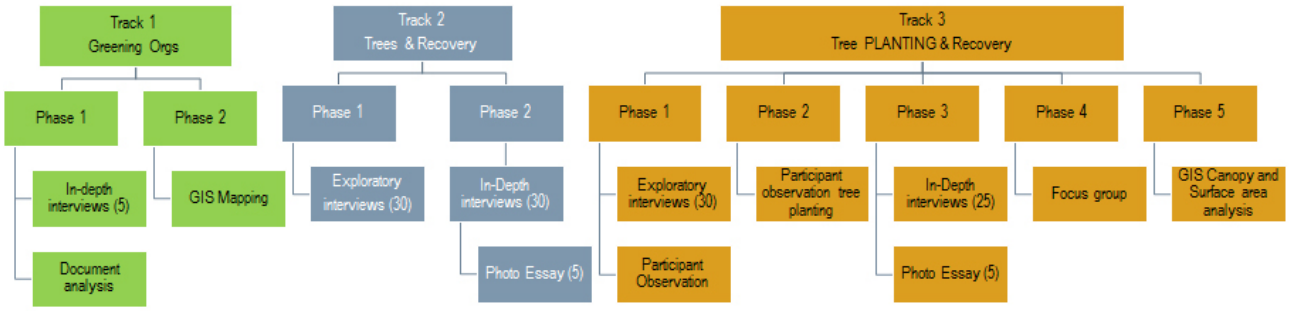
Thus, constructing a model allows a researcher to test the model as a hypothetical description of actually existing entities and their relationships. The model can be empirically tested. This testing could be by indirect testing of the truth or falsity of the theoretical statements or, by observation, detecting or infering the presence of entities designated by certain theoretical terms (Keat and Urry 1980). This is, of course, in dissonance with the positivist idea of theoretical terms which must correspond to the observation language to be meaningful. If the model is not rejected by empirical test, this gives the critical realist researcher a good reason to conclude (or more strongly suspect) that the mechanisms and structures do in fact exist. Therefore, the reciprocity between model constructing and testing can potentially give an explanation of the original phenomena of interest and the mechanisms and structures at work.

Methods

The goal of this research and dissertation has been to determine and describe the role of urban trees and community forestry activities in post-Katrina resilience in New Orleans, so that in other similar circumstances, greening activities such as urban community forestry might be considered as an option for application. By first modeling a hypothetical mechanistic explanation for why greening might occur in a post-disaster context (Tidball and Krasny 2008a; Tidball and Krasny 2008b), I approached community forestry activities in post-Katrina New Orleans from a critical realist perspective. I approached this goal using three related research objectives, all of which would help refine the retroductively induced hypothetical model or mechanistic

explanation referenced above -- (1) characterization of community forestry organizations and their practices, (2) determining the value of *trees and urban forests* in recovery, and (3) determining the value of *active engagement in urban forestry activities* in recovery. Through these research objectives a better understanding of both how trees, and perhaps more importantly how the act of meaningfully interacting with trees, acted as mechanisms that enhance individual and social-ecological system resilience in cities following disaster was gained. Figure A.3-4 provides an overview of the methods used to address the research questions and phases within each question. Though the methodological approach above and the methods described below were all employed in this study, not all data produced appears in the chapters of the dissertation. Some data will appear in future papers, and some data was found to be unsuitable for further use, through sampling errors, inaccuracy, technological limitations, etc.

Figure A1.4. Mixed Methods Model employed



The research approach for question 1 draws from institutional analysis methods used in forestry studies, which opened up the possibility of viewing post-Katrina community forestry practices as an innovation (innovations later gave way to distributed communities of practice). The methods entailed interviews and document review and use of GIS (see Appendices 2 and 3 for elaboration on GIS methods). The approach for questions 2 and 3 draws from research focused on people's responses to trees, and includes qualitative interviews, photo-elicitation/ photo-essay, and focus group interviews. Through integrating quantitative and qualitative approaches within each research question, and across all the stages of the research process, this research approach goes beyond simple mixed methods approaches that use a blend of quantitative and qualitative methods (Mingers J. 1997), and can be described as a "mixed models" approach (Tashakkori and Teddlie 2003), consistent with the earlier discussion regarding a realist ontology, a critical realist and systems theory epistemology, and a retroductive, modeling, resilience thinking methodology. A mixed models study is a product of the pragmatist paradigm, combining qualitative and quantitative approaches within and across different phases of the research process, a research design representing the highest degree of mixing of paradigms (Tashakkori and Teddlie 1998). The rationale for using this mixed models approach is informed by (Greene, Caracelli et al. 1989), who outline five features of such an approach that help to ensure validity of research results, including triangulation, complementarity, development, initiation, and expansion.[22] For example, in this particular study,

[22] *Triangulation* seeks convergence, corroboration, and correspondence of results from different methods. *Complementarity* seeks elaboration, enhancement, illustration, and clarification of the results from one method with the results of another method. *Development* seeks to use the results of one method to help develop of inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions. *Initiation* seeks the discovery of paradox

qualitative methods were used to inform the choice of sample population and the development of measures for the quantitative GIS analysis (development), as well as to elaborate, enhance, illustrate, and clarify the results from the quantitative aspects of the study (complementarity). Various sources of data were triangulated to discover contradictions and develop new perspectives on retroductive hypothetical conceptual models, and different study components were used to extend the breadth and range of inquiry (expansion) (Tashakkori and Teddlie 2003).

Figure A1.5. Research Methods Overview

Research Question 1. Urban community forestry organizations/agencies and their practices.
Phase 1. *In-depth Interviews* with 5 organization/agency leaders, *Document Analysis* of organization/agency reports and strategic plans
Phase 2. *GIS Maps* of urban forestry activities

Research Question 2. Trees and Recovery
Phase 1. *Exploratory Interviews* with 30 residents
Phase 2. *In-depth Interviews and Photo-Elicitation* with 5 residents

Research Question 3. Tree Planting and Recovery
Phase 1. *Exploratory Interviews* with 30 volunteer community foresters
Phase 2. *Participant Observation* of tree planting, caring, removal, and monitoring activities over multiple 2-week periods
Phase 3. *In-depth Interviews and Photo-Elicitation* with 5 volunteer community foresters
Phase 4. *Focus Group* with 7-10 volunteer community foresters
Phase 5. GIS Urban Canopy Analysis and Surface Area Analysis

and contradiction, new perspectives or frameworks, and the recasting of questions or results from one method with questions or results from another method. *Expansion* seeks to extend the breadth and range of inquiry by using different methods for different inquiry components (Greene et al 1989).

In addition to the means for helping to ensure validity described above, a "member check" or a systematic query for feedback from the study subjects at each stage of the research was initiated (Maxwell 2006). Through this participatory approach, the research process was informed by and calibrated with the people who live in New Orleans. This research also followed all federal, state, and Cornell University regulations for the use of Human Subjects in answering the research questions.

Consistent with participatory research theory and practice, throughout the various phases of the research, creation of multiple products that could be used in outreach was prioritized. These included audiovisual files of the in-depth interviews for posting on collaborators' websites (with appropriate permissions), website visual graphics, GIS maps, and graphs and tables summarizing the quantitative aspects of the study. Below is a description of the methods for each research question.

Research Question 1 (RQ 1). How can we characterize the competencies, capabilities, and actions exhibited by community organizations and government agencies involved in urban community forestry in post-Katrina New Orleans?

To answer questions about community organizations and government agencies, in-depth interviews were conducted and important documents reviewed to develop an understanding of competencies, capabilities, and actions as perceived by the leaders of these institutions (phase 1, RQ 1). Next, collaboration with partner organizations and a

colleague at Cornell was initiated to develop GIS layers of the tree planting and related activities they were conducting in partnership with volunteer community foresters (phase 2, RQ 1). The results from RQ 1 provided illustration of a distributed community of practice as well as more indirect indicators of biological and landscape diversity, adaptive learning and resource management, self-organization, and overlap in governance, all of which are indicators of social-ecological resilience (see chapters 4 and 5, this volume). RQ 1 also generated two products: (1) descriptions of the processes through which community organizations create urban forestry communities of practice in response to catastrophic tree and human loss (see chapters 2 and 4, this volume) and (2) GIS maps showing the location of trees, urban forestry activities, and limited social and demographic factors (see Appendices 2 and 3, this volume)

Phase 1 (RQ 1). Institutional analysis focusing on innovations. Initially this study adapted the methods used by Wolf and Primmer (2006) in their study of the processes through which non-profit organizations and government agencies working to conserve forest biodiversity pursue conservation innovations. The aim of Wolf and Primmer's (2006) research was to identify positive models of innovation, which the authors define as new ways of producing services and goods that enhance the environment. Because innovations and related adaptive learning and adaptive management are critical to the resilience of socio-ecological systems (Walker and Salt 2006), using a method for institutional analysis that focuses on innovation was thought to provide

critical indicators of social resilience (Carpenter and Cottingham 1997).[23] Further, a framework emphasizing innovations and adaptive learning was particularly appropriate for a situation such as post-Katrina New Orleans, where the extreme conditions faced by foresters and citizens required new ways of thinking, managing, and learning. However, as the study continued, it became clear that a communities of practice approach was more suitable for understanding the reforestation activities in New Orleans, so the interview data were analyzed using this alternate framework (the communities of practice research is incomplete and as of yet unpublished) as a lens to analyze and organize data.

Structured, in-person interviews were conducted with leaders of the three community organizations that were cooperators on this project (Parkway Partners, Hike for KaTREEna, and Replant New Orleans) and with the State of Louisiana and City of New Orleans urban foresters.[24] Based on available information, these five organizations/agencies represented the major formal players in urban community forestry in post-Katrina New Orleans.

The interview protocol included measures of the organizations' or agencies': (1) internal competencies, including human capital (e.g., education level) and organizational routines (e.g., mission statements); (2) external competencies or

[23] Note that although the Wolf and Primmer (2006) method focuses on innovative practices, through analyzing the process by which urban forestry community organizations and government agencies respond to disaster, we also will obtain information on learning, adaptive management, self-organization (how community-driven initiatives emerge after a disaster), and overlap in governance (roles of community organizations and government). Furthermore, through the GIS mapping also carried out as part of this objective (see below), we will gain ecosystem measures of resilience, including diversity of tree species and of landscapes.
[24] We have agreements to participate in this study from the three community organizations and the LA state urban forester (see letters of support). We have spoken several times to staff in the City of New Orleans urban forester's office and hope to receive his permission to be interviewed soon.

linkages to resources of external actors (e.g., ability of community organization to access government provided trees); (3) capabilities, or ability to do new things or do things differently to conserve natural resources (e.g., organizational ability to switch from pre-Katrina nature protection to post-Katrina restoration); and (4) action, which was referred to as "multi-functionality" or "derivation of multiple benefits by a set of diverse actors in a temporally and spatially defined context" (e.g., tree planting, tree care, tree health monitoring, and tree removal; and number, species, and locations of trees planted and cared for, Wolf and Primmer 2006). After developing measures for each of these factors, a list of interview topics was provided to each interviewee prior to the interview.

During the interviews, which took place at the subject's office, I also collected organizational documents describing organizational mission, resources, and accomplishments, as well as any maps showing locations of tree planting and other forestry efforts. The organizational documents and transcriptions of the interviews were analyzed for content and coded (Maxwell 1996), and were used to develop separate narratives, summary tables, and organizational diagrams describing the processes by which each organization or agency achieves innovations related to urban forest conservation and restoration in post-Katrina New Orleans. These products were of limited use in the analysis as this research evolved and do not appear in the dissertation, but were used by the partnering community groups in multiple ways (see http://www.sci-links.com/nola.html for many examples of such products).

Phase 2 (RQ 1). GIS Maps. I used existing data (USGS, USDA, and State of Louisiana, among others) and data collected through this project to create maps showing locations of trees and of tree planting, tree care, tree monitoring, and tree removal activities. These maps were used to construct GIS layers showing the spatial location of the urban community forestry practices in New Orleans. The data layers were added onto publicly available GIS layers[25] of demographic and social data, including such variables as vacant and adjudicated lots (*e.g.*, how many residents have returned since the storm), as well as forest data, including degree of damage to trees and tree cover by neighborhood pre- and post-Katrina. Wherever possible, I used existing data layers that embodied variables used in studies to attempt to characterize resilience in social-ecological systems (*e.g.*, presence of civic organizations, diversity of tree species). Using the GIS layers, I attempted to correlate post-Katrina tree planting activity with pre- and post-Katrina demographic, social, and tree data in a manner that would help to better understand the role of community forestry in post-Katrina resilience (see appendices 2 and 3, this volume).

Research Question 2 (RQ 2). How do residents describe the role of trees and urban forests in their ability to recover from Katrina?

The research to address RQ 2 was conducted in three phases: (1) "Exploratory Interviewing and Item Generation," (2) "Narratives and Individual Accounts" (Weller 1998), and (3) quantitative surveys. Throughout the three phases, I engaged New

[25] We will use data available through the Greater New Orleans Community Data Center, www.gnocdc.org, the State of Louisiana's Hurricane Katrina information clearinghouse, http://www.katrina.louisiana.gov/index.html, and other sources.

Orleans residents in a participatory fashion, through encouraging residents to help identify study questions and carry out surveys.

The results of RQ 2 and of RQ 3 (see below) provided rich qualitative and quantitative data that helped to develop a deeper understanding of the role of trees and of community-initiated tree planting and related activities in the recovery of individuals from Hurricane Katrina. This understanding of individual level recovery is unique among studies of social-ecological systems resilience, and arguably formed a critical piece of the puzzle in contributing to understanding of mechanisms that confer social-ecological system resilience. This aspect of the study also was unique among resilience research in its integration of social and ecosystem measures into one construct (community initiated tree planting and related volunteer community forestry practices). Finally, questions 2 and 3 provided multiple sources of data for use in participatory research outreach products.

Site Selection (RQ 2)

To guide the choice of study locations for RQ 2, I worked with my community partner organizations, and used GIS maps compiled through RQ 1. In particular, I identified study populations for the RQ 2 interviews and surveys who resided in neighborhoods varying in demographics, tree canopy pre- and post-Katrina, and tree planting activities.

Phase 1 (RQ 2). Exploratory Interviews. During phase 1, "Exploratory Interviewing and Item Generation" (Weller 1998), I conducted 30 short (5-10 minute), exploratory interviews of New Orleans residents affected by the storm, selected through convenience sampling within neighborhoods varying in the tree canopy, tree replanting, and demographic factors as described under site selection above. These interviews contributed to development of the quantitative surveys in phase 3 (RQ 2), and helped me gain a better grasp of factors important to New Orleans residents and of terminology they use to describe their experiences. Thus, the exploratory interviews enabled me to adapt and learn how to phrase my research questions to be relevant and resonant (rather than off-putting and alienating) to the sample population. Questions asked during these short interviews included: "Can you tell me about trees in your neighborhood?" "Have trees been important to you during your recovery from Katrina? If so, can you explain how?"

I transcribed and coded these data. Codes were inductively generated from the transcripts as opposed to fitting data into predetermined categories. Next I constructed matrices from the data to identify patterns and paradoxes, and to be able to readily compare these data with data from other aspects of the study (Maxwell 1996). Through analyzing the data independently of other phases of the research, I was able to arrive at commonalities and themes in post-Katrina trees and recovery discourses; in this way these data "complemented" and "expanded" on other phases of the study (Greene, Caracelli et al. 1989; Tashakkori and Teddlie 2003). The data from the short

interviews were also used to develop questions for the in-depth interviews in phase 2 (RQ 2).

Phase 2 (RQ 2). ***In-depth Interviews and Photo-Elicitation/Photo-Essay.*** Phase 2 (RQ 2) was informed by Weller's (1998) "Narratives and Individual Accounts." During this phase, I conducted expanded, in-depth, unstructured and exhaustive interviews of five individuals who referenced trees as part of their recovery during the 30 short exploratory interviews from phase 1 (RQ 2). I recorded and transcribed the interviews, and analyzed and coded the data as described for phase 1 (RQ 2) above. These interviews provided a rich source of data, which served to complement and expand other sources of data, and to help ensure validity of the overall study. Further, the results of this phase were used along with the results of phase 1 (RQ 2) to develop survey questions for phase 3 (RQ 2).

In addition to collecting the narratives, I provided the five interviewees with a camera and asked them to "photo-essay" their response to the question: "How do trees matter to me after Katrina?" I coded the photographs for emergent themes. Then, I asked the interviewees to write descriptive text about their photos and the meanings therein. I coded these texts, after a process of clarification and further elaboration. This qualitative research method, known as "photo-elicitation,"[26] was used to suggest possible interconnections and relationships across themes derived from the interviews,

[26] John Bliss, Professor and Associate Department Head, Department of Forest Resources, Oregon State University, personal communication. http://www.cof.orst.edu/cof/fr/facultypages/bliss.php

and to seek elaboration, illustration, and clarification of the results of other aspects of the survey.

The audio recordings and participatory photo-essays also provided a source for documentation of real "stories" for website and other research and outreach products that were requested by the community partners (used with appropriate permissions). Some of these photo-essays appear in Chapter 4 of this dissertation (a future paper will focus more on these photo essays).

Phase 3 (RQ 2). Quantitative Surveys. During phase 3 (RQ 2), I used close-ended, written surveys, which were administered in-person to 15 New Orleans Tree Troopers, selected through systematic sampling.[27] By administering the survey to residents from different New Orleans neighborhoods, and by comparing results to patterns discerned from GIS maps generated in RQ 1, I was able to develop correlations and see patterns among the various ways in which residents characterize the role of trees in their recovery, and neighborhood tree, tree planting, and demographic variables.

I used the results of phases 1 and 2 (RQ 2), as well as a small, informal focus group of residents selected from the original 30 residents interviewed, to develop the close-ended survey. The results of phases 1 and 2 (RQ 2) determined the items on the close-ended survey, and reflected the following kinds of questions: Does the presence or absence of trees in your neighborhood: (1) help you define the character of your

[27] For example, we will select every 10th name from the list of residents in a particular neighborhood. Assuming the list is randomized, this is a type of probability sampling. It is easy to implement and the stratification induced can make it efficient (http://www.socialresearchmethods.net/kb/sampnon.php).

neighborhood? (2) contribute meaning to your life? (3) help connect you to your past? (4) help you connect to other residents? (5) help you feel more secure/ healthy? (6) help you recover from Katrina? The survey utilized a Likert scale (Likert 1932) to indicate the strength of each factor and to facilitate data analysis. Results of the survey were analyzed using standard statistical software, and may be compiled into tables for journal articles and figures for presentation to lay audiences in the future.

<u>Research Question 3 (RQ 3)</u>. How do volunteer community foresters, or residents who are actively engaged in community initiated management of trees and forests (e.g., through monitoring damage, caring for damaged trees, tree planting), describe the value of active engagement in urban forestry activities in their ability to recover post-Katrina?

Similar to RQ 2, RQ 3 integrated both qualitative and quantitative methods. However, because it was more difficult to build an understanding of how people value an *activity* such as volunteer tree planting, as opposed to how they value an *object* such as a tree, this aspect of the research involved five instead of three phases of data collection. In addition to the three phases used in RQ 2, the methods for RQ 3 included participant observation to help develop a better understanding of volunteer community forestry practices, and more formal focus group interviews to help develop the written survey. New Orleans residents were invited to participate throughout RQ 3, through helping to address study questions and administering the written surveys.

Site Selection (RQ 3)

To guide the choice of study locations for question 3, I worked with my community partner organizations, and used GIS maps compiled through RQ 1. In particular, for the RQ 3 interviews and surveys I identified study populations who conducted volunteer community forestry activities in neighborhoods varying in demographics and in tree canopy pre- and post-Katrina.

Phase 1 (RQ 3). Exploratory Interviews. As in research RQ 2, phase 1 (RQ 3) used Weller's (1998) qualitative method "Exploratory Interviewing and Item Generation," only in this case I conducted 30 short (5-10 minutes) exploratory interviews of volunteer community foresters rather than of any randomly chosen resident. The interviewees were identified through a combination of conversations with the New Orleans community forestry partners and snowball sampling.[28] These interviews enabled me to adapt and learn how to phrase my research questions to be relevant and resonant (rather than off-putting and alienating) to the sample population. Questions asked during these short interviews included: "Can you tell me about tree planting in your neighborhood?" "Can you tell me about tree removal in your neighborhood?" "Has caring for trees been important to you during your recovery from Katrina? If so, can you explain how?"

[28] In snowball sampling, you begin by identifying someone who meets the criteria for inclusion in your study. You then ask them to recommend others who they may know who also meet the criteria. Although this method would hardly lead to representative samples, there are times when it may be the best method available. Snowball sampling is especially useful when you are trying to reach populations that are inaccessible or hard to find (http://www.socialresearchmethods.net/kb/sampnon.php).

Data analysis methods were similar to those for phase 1 of RQ 2 described above. I transcribed and coded the data. Codes were inductively generated from the transcripts rather than fitting data into predetermined categories. Next I constructed matrices from the data to identify patterns and paradoxes, and to be able to readily compare these data with data from other aspects of the study (Maxwell 1996). Through analyzing the data independently of other phases of the research, I was able to arrive at commonalities and themes in post-Katrina volunteer community forestry and recovery discourses; in this way these data "complemented" and "expanded" on other phases of the study (Tashakkori and Teddlie 2003). The data from the short interviews were also used to develop questions for the in-depth questions in phase 5 (RQ 3).

Phase 2 (RQ 3). Participant Observation. In phase 2 (RQ 3), I engaged in predominantly ethnographic "fieldwork" focusing on participant observation, which is accepted almost universally as the central and defining method of research in cultural anthropology (Mead 1928; Malinowski 1929; Evans-Pritchard 1940; Geertz 1984; DeWalt, DeWalt et al. 1998). Participant observation entails explicitly recording information about behaviors gained from participating and observing (DeWalt, DeWalt et al. 1998), and implies a particular approach to carefully and extensively recording observations in field notes. The information the ethnographer gains through participation is considered critical to social scientific analysis, similar to more formal research techniques like interviewing, structured observation, and the use of surveys. Detailed, descriptive note taking about specific, concrete events observed and visual documentation helped to ensure validity (Maxwell 1996).

I engaged in participant observation with volunteer community foresters for two periods of two weeks, during which I compiled comprehensive field notes. I accompanied community forestry volunteers as they planted or otherwise cared for trees, engaged in processes to secure additional resources, participated in informal gatherings, etc. Although anthropologists have historically cast a very wide net in their ethnographic work, this research attempted to limit the scope of behavioral observation to targeted activities, *i.e.*, those directly or indirectly related to volunteer community forestry. For example, I explored such phenomena as symbolism of tree planting, tree planting ritual and tradition, and sub-cultural norms and mores related to volunteering (see chapter 4, this volume). The recorded observations were collections of textual descriptions that I coded using categories developed once the participant observations were complete, consistent with earlier coding methods.

Phase 3 (RQ 3). In-depth Interviews and Photo-Elicitation. Phase 3 (RQ 3) was informed by Weller's (1998) "Narratives and Individual Accounts." During this phase, I conducted expanded, in-depth, unstructured and exhaustive interviews of five individuals who referenced tree planting, caring for trees, and removing dead trees as part of their recovery during the 30 short exploratory interviews from phase 1 (RQ 3). I recorded and transcribed the interviews, and analyzed and coded the data as described for phase 2 of RQ 2 above. Again, the interviews provided data which served to complement and expand other sources of data, and helped ensure validity of

the overall study. Further, the results of this phase were used along with the results of phase 1 (RQ 3) to develop survey questions for phase 5 (RQ 3) (below).

In addition to collecting the narratives, I provided the five interviewees with a camera and asked them to "photo-essay" their response to the question: "How does tree planting, tree care, and tree removal matter to me after Katrina?" I coded the photographs for emergent themes. This qualitative and participatory research method, known variously as participatory photography, photo-elicitation, photo-voice or photo-essay (Collier and Collier 1986 [1967]; Wang and Burris 1994; Wang, Burris et al. 1996; Wang 1999; Singhal and Devi 2003; Stedman, Beckley et al. 2004), was used to suggest possible interconnections and relationships across themes derived from the interviews, and to seek elaboration, illustration, and clarification of the results of interviews and participant observation.

Phase 4 (RQ 3). Focus Group. During phase 4 (RQ 3), I used discourse-based valuation (Wilson and Howarth 2002) within a focus group of 7-10 (some participants arrived late, some left early) volunteer community foresters to develop agreed upon values or orderings for multiple entities derived from phases 1-3 (RQ 3). The participants created an agreed-upon preference ordering of entities or concepts, but did not develop relationships among variables or value entities. The results of the discourse-based valuation assisted in making decisions about the survey instrument (and in the end, a determination to dispense with the larger survey) for phase 5.

Phase 5 (RQ 3). Quantitative Survey. Finally, in phase 5 (RQ 3), we used the results of Phases 1-4 (RQ 3) to develop a close-ended survey to be administered to 200 community forestry volunteers, selected through purposive expert sampling (Patton 1990).[29] The survey was to be administered during a time when volunteer community foresters assemble for their tree planting and other activities. Sample questions proposed included: Does participation in volunteer tree planting: (1) help demonstrate your commitment to the future? (2) enhance the urban landscape? (3) reduce pollution or greenhouse gases? (4) demonstrate your civic involvement? (5) show that you are managing and learning how to manage urban forests? (6) demonstrate your ability to solve problems yourself? (7) demonstrate the ability of the city to continue functioning as it did pre-Katrina? The survey was to utilize a Likert scale (Likert 1932) to indicate the strength of each factor and to facilitate data analysis. Results from the survey were to be analyzed using standard statistical software, and were to be compiled into tables for journal articles and figures for presentation to lay audiences. The survey was, in the end, postponed due to a tragic death within the Tree Trooper community that had an effect on my ability to conduct survey research in an ethical and empathetic way. It is unclear whether this survey would still be relevant to conduct in 2012 or beyond.

[29] Subjects are selected because of some characteristic, in this case participation in volunteer community forestry (Patton 1990).

Analysis

Textual data from all phases of the mixed model research were transcribed by a contracted transcriptionist. Interviews were analyzed using Leximancer content analysis software and Atlas.ti. To analyze large amounts of textual data, I followed procedures outlined by Auerback and Silverstein (2003). I read and reviewed textual data multiple times and then selected "relevant text" from each interview or interaction for additional analysis. Using key words from my ethnographic notes, I inserted a memo for each passage of text that I highlighted indicating its importance and reflecting its meaning in relation to my retroductive hypothetical model and research questions and in relation to other transcripts (an approach called "pre-coding," Saldana 2009). As recurring ideas began to emerge from the data, I began documenting similarities among them and then began grouping them in categories that eventually became themes. After reviewing all textual data, I compiled lists of codes based on the emergent themes from the data and then assigned them theme names within the content analysis software so that I would be able to access and sort quotes and memos by theme rather than by date or interviewee. During this process, I employed "constant comparison" to refine codes, often returning to earlier texts to recode, group codes together, or split overly general codes into two or more codes (Strauss and Corbin 1990, pp. 75-95). Initial or open codes (Charmaz 2006) used were varied and included structural codes (indicating question asked), descriptive codes (identifying topics), process codes (describing actions or cause and effect), and holistic

codes (broader concepts) (Saldana 2009). After examining the data coded for each theme, focused coding (Charmaz 2006; Saldana 2009) was then used for another iteration of grouping themes together into emergent categories. During this process of refining emergent categories and themes, I attempted to ensure that they were sensitive to the data, “exhaustive” yet “mutually exclusive,” and “conceptually congruent” (Merriam 2009).

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APPENDIX 2

PARKWAY PARTNERS TREE PLANTING DATA AND ANALYSIS

Introduction

A critically important partner in the participatory research conducted for this dissertation is an organization in New Orleans called Parkway Partners. For 28 years, with the help of Parkway Partners, New Orleans has met the criteria to be recognized as a Tree City under The Tree City USA® program, sponsored by the Arbor Day Foundation in cooperation with the USDA Forest Service and the National Association of State Foresters.[30] Parkway Partners has historically been very involved in efforts to create "The Big Green Easy," as evidenced by efforts by the City of New Orleans to enact a tree ordinance[31] and by virtue of the creation of a Department of Parks and Parkways full time Urban Forester and two Landscape Architect positions, who ensure compliance with the City's current tree ordinance. Figure A2.1 depicts the logo of Parkway Partners, which began in 1982 as a citizen arm of the New Orleans Department of Parks and Parkways. Parkway Partners organizes the Annual Arbor Day Celebration, which includes a proclamation issued by the City Council. Parkway Partners promote the sustainability social, environmental and economic concepts.

[30] TreeCityUSA, http://www.arborday.org/programs/treeCityUSA/about.cfm

[31] http://www.nola.gov/en/sitecore/content/Root/GOVERNMENT/Department-of-Parks-and-Parkways/Street-Tree-Planting-Guide.aspx

Figure A2.1 Parkway Partners in New Orleans logo. Note the explicit symbolism in the image's integration if humans and trees, as described in Chapter 4 of this dissertation.

Various initiatives have been pursued over the years by Parkway Partners in New Orleans. Prior to Hurricane Katrina, Parkway Partners was focused on community gardens and common spaces throughout the city. After Hurricane Katrina, Parkway Partners moved its focus to replanting the severely damaged urban forest of New Orleans. In 2008-2009, Parkway Partners initiated a specific tree planting program targeted to under-resourced neighborhoods in New Orleans. The "Ten Trees for the Neighborhood" program (often called "Ten for the Hood") challenged residents to plant ten free street-to-sidewalk trees, in cooperation with their neighbors, all on one day, after signing written agreements to maintain them, and under the supervision of Parkway Partners Tree Troopers. All "Ten Trees" applications were reviewed by the New Orleans Department of Parks and Parkways to verify that appropriate species and sites were selected.

Figure A2.2 School children in the Lower 9th Ward of New Orleans after receiving their "Ten for the Hood" trees.

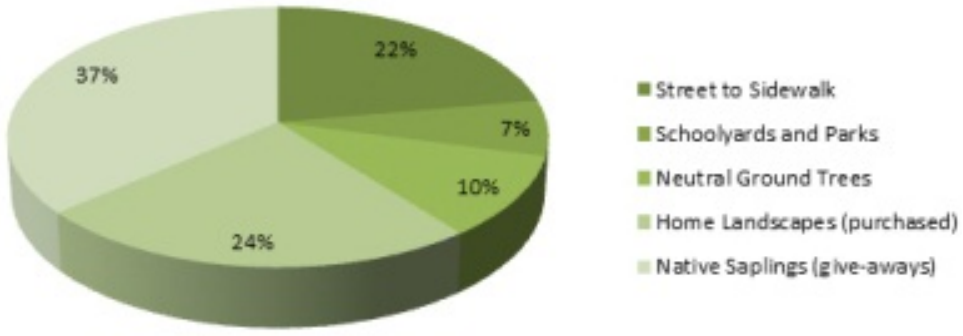


Figure A2.3 Parkway Partners "ReLeaf New Orleans" Post-Katrina trees planted, by site type through Mar of 2009.

In the 2010-2011 planting season, Parkway Partners replaced 2,300 trees to continue the ReLeaf New Orleans efforts of motivating and equipping New Orleans residents to replace all street-to-sidewalk trees killed by the storm and flooding. Each year since

2005 has seen an increase in the numbers of trees planted and the numbers of volunteers enlisted to plant and care for those trees (see Figure 6.6 in Chapter 6, this volume).

Tree Troopers

A free three-part training workshop is conducted annually by Parkway Partners called "Tree Troopers." This training was begun after Hurricane Katrina when Parkway Partners recognized the need to help build a tree planting community of practice in New Orleans. Residents are required to attend all three sessions to become a certified Tree Trooper. Topics covered include the benefits of trees, the physiology of trees, insects and tree disease, urban soils, proper planting, green laws, and pruning and caring for newly planted and mature trees. Instructors are Tom Campbell, Urban Forestry Program Director; Dan Gill, LSU Agricultural Center; Ginger Fortson, consulting horticulturist; and Brook Burmaster, Gretna Tree Board. Requirements for certification include 12 hours of classroom and field instruction and a commitment of at least 12 hours of volunteering.

The scope of Parkway Partners has broadened to encompass more than 2,000 acres of public green space, including parks, playgrounds, historical monuments and neutral grounds. Educational programs have also been established for school students and the community.

In 2009 Parkway Partners, in conjunction with the Cornell Civic Ecology Lab via Tidball's participatory research, recognized a need to systematize and establish a comprehensive street-to-sidewalk tree inventory to identify underserved neighborhoods. To address the need for an inventory, Parkway Partners launched an initiative called the Strategic ReLeaf Program in a collaborative effort to investigate how citizen-led efforts to ReLeaf New Orleans Urban Forests after Hurricane Katrina might impact not only the ecosystem which was damaged, but also affect the psychological and social recovery of the participants.

The following is statistical information from Tree Trooper Training (3 cohorts) in Fall 2006, Spring 2007, and Summer 2008.

Number of Graduates : 63
Female: 49 Male: 14
Ethnicity: W 56, H 2, A 1, B 4
Ages Ranging from 11 years (Home Schooled Child) to 74 years

Representing Zip Codes:

70001	1	70117	3
70002	3	70118	7
70005	3	70119	6
70043	2	70121	3
70047	1	70122	4
70053	2	70123	2
70054	1	70124	4
70065	1	70125	1
70113	3	70130	2
70114	2	70175	2
70015	7	70184	1
70116	2		

Mapping ReLeaf New Orleans

For the Strategic ReLeaf Program, Tidball recruited GIS expertise from Cornell University's Department of City and Regional Planning to work collaboratively with Parkway Partners to document the canopy cover greening efforts as reforestation proceeded from 2005 to 2011. Research involved use of pre-Katrina tree canopy data (less than one year before the storm), one month post-Katrina data, and data four years post-Katrina to generate an understanding of the aerial extent of tree cover at specific times (see Appendix 3, this volume).

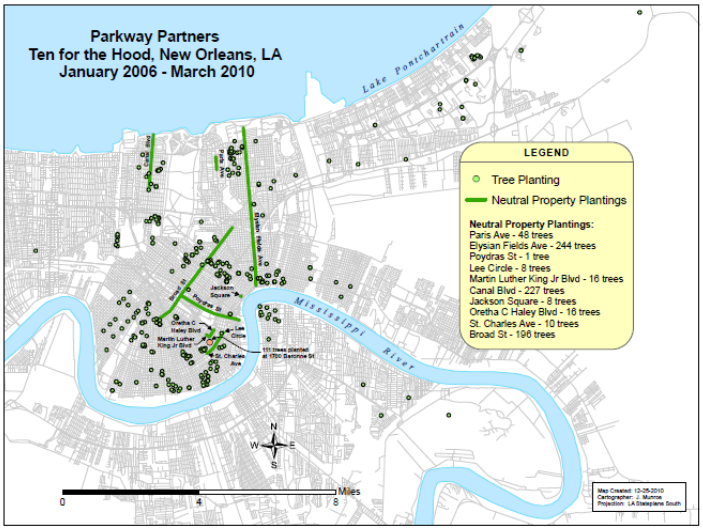
At the same time, (June of 2010) a team of six federal employees who were enrolled in the USDA's Graduate School Executive Leadership Program (ELP) contacted Tidball with interest in doing a team project around the theme of greening. They were referred by colleagues at the US Forest Service Northern Research Station in New York City. Tidball shared with them his work in post-Katrina New Orleans and indicated that there were a number of sub-projects that were of interest to him and to his partner organizations in New Orleans, and that would be useful in augmenting core PhD research, but that there was a lack of sufficient "human power" to complete. These six persons agreed to assist Tidball with a Parkway Partners Ten for the Hood program mapping project with great gusto, as described below.

Methods

The team worked with Tidball to convert Parkway Partners' Ten-for-the-Hood address data from plantings between January 2006 and March 2010 to GIS coordinates. Addresses of locations where Parkway Partners "Ten for the Hood" trees were planted were converted to GIS coordinates using the University of Southern California's (USC) web GIS Services laboratory's free software service[32] . Those coordinates were then plotted on maps generated by Tidball and the USDA's Graduate School Executive Leadership Program (ELP) team using ARCView software.

Figure A2.4 shows the finished product, giving an overall perspective of the range of tree planting in New Orleans that has happened as a result of the Parkway Partners' Ten for the Hood initiative.

Figure A2.4.



[32] http://webgis.usc.edu/Services/Geocode/Default.aspx

Figure A2.5 gives a sense of scale for the mapping of planted trees. It illustrates the capability of the software to depict the number of trees planted in any location as represented by one black dot. The inserted ortho-photo shows a satellite view of a planting of 111 trees planted in a specific location.

Figure A2.5.

The above information has been made use of by Parkway Partners to further their important work of supporting trees and tree planting in post-Katrina New Orleans. In particular, being able to visually identify areas that have had little or no tree-planting activity has helped parkway Partners plan more strategically in terms of Tree Trooper recruitment and targeting large scale neighborhood plantings. The GIS information

was useful in further analysis of the physical impacts (in terms of tree canopy coverage) of community-based tree planting efforts (see Appendix 3, this volume). Below is a table of all data used to complete the mapping exercise, and some examples of forms used for “Ten for the Hood” plantings.

Address and GIS Data

Identifier	Street Address	City	State	Zip	Latitude	Longitude
2	1035 1st Street	New Orleans	LA	70130	29.92753	-90.0787
3	836 4th Street	New Orleans	LA	70130	29.92441	-90.0801
4	838 4th Street	New Orleans	LA	70130	29.92443	-90.0801
5	825 4th Street	New Orleans	LA	70130	29.92443	-90.0798
6	821 4th Street	New Orleans	LA	70130	29.92439	-90.0798
7	918 6th Street	New Orleans	LA	70115	29.9239	-90.0827
8	527 6th Street	New Orleans	LA	70115	29.92089	-90.0803
9	939 6th Street	New Orleans	LA	70115	29.92418	-90.0827
10	612 7th Street	New Orleans	LA	70115	29.92084	-90.0816
11	609 7th Street	New Orleans	LA	70115	29.92092	-90.0815
12	744 7th Street	New Orleans	LA	70115	29.92191	-90.0824
13	615 8th Street	New Orleans	LA	70115	29.9205	-90.0823
14	165 Alix Street	New Orleans	LA	70114	29.9501	-90.0539
15	59 Allard Street	New Orleans	LA	70119	29.98091	-90.0952
16	3900 Annunciation Street	New Orleans	LA	70115	29.9184	-90.0942
17	3470 Annunciation Street	New Orleans	LA	70115	29.91958	-90.0891
18	4035 Annunciation Street	New Orleans	LA	70115	29.91836	-90.0969
19	4029 Annunciation Street	New Orleans	LA	70115	29.91837	-90.0969
20	3471 Annunciation Street	New Orleans	LA	70115	29.91973	-90.0893
21	6744 Argonne Boulevard	New Orleans	LA	70124	30.01259	-90.1019
22	805 Atlantic Avenue	New Orleans	LA	70114	29.94745	-90.0453
23	2237 Audubon Street	New Orleans	LA	70125	29.94979	-90.1157
24	2406 Audubon Street	New Orleans	LA	70125	29.95174	-90.1144
25	2523 Audubon Street	New Orleans	LA	70125	29.95249	-90.1136
26	816 Austerlitz Street	New Orleans	LA	70115	29.92038	-90.0957
27	2232 Baronne Street	New Orleans	LA	70113	29.93595	-90.0829
28	2218 Baronne Street	New Orleans	LA	70113	29.93607	-90.0827
29	2259 Baronne Street	New Orleans	LA	70113	29.93587	-90.0833
30	2234 Baronne Street	New Orleans	LA	70113	29.93593	-90.0829
31	331 Bellaire Drive	New Orleans	LA	70124	29.98419	-90.1231
32	370 Bellaire Drive	New Orleans	LA	70124	29.98512	-90.1232

33	345 Bellaire Drive	New Orleans	LA	70124	29.98451	-90.1231
34	123 Bellaire Drive	New Orleans	LA	70124	29.97996	-90.1232
35	321 Bellaire Drive	New Orleans	LA	70124	29.98396	-90.1231
36	336 Bellaire Drive	New Orleans	LA	70124	29.98434	-90.1233
37	334 Bellaire Drive	New Orleans	LA	70124	29.98429	-90.1233
38	250 Bellaire Drive	New Orleans	LA	70124	29.98247	-90.1234
39	366 Bellaire Drive	New Orleans	LA	70124	29.98503	-90.1232
40	528 Bouny Street	New Orleans	LA	70114	29.95028	-90.0533
41	2119 Brainard Street	New Orleans	LA	70113	29.9362	-90.0812
42	2227 Brainard Street	New Orleans	LA	70113	29.93545	-90.0823
43	2259 Brainard Street	New Orleans	LA	70113	29.93516	-90.0828
44	2123 Brainard Street	New Orleans	LA	70113	29.93617	-90.0812
45	7935 Burthe Street	New Orleans	LA	70118	29.94418	-90.1305
46	2402 Calhoun Street	New Orleans	LA	70118	29.94007	-90.1171
47	2625 Calhoun Street	New Orleans	LA	70118	29.94191	-90.116
48	6000 Cameron Boulevard	New Orleans	LA	70122	30.01916	-90.0646
49	5334 Cameron Boulevard	New Orleans	LA	70122	30.01268	-90.064
50	324 Camp Street	New Orleans	LA	70130	29.95078	-90.0688
51	324 Camp Street	New Orleans	LA	70130	29.95078	-90.0688
52	6612 Canal Boulevard	New Orleans	LA	70124	30.01067	-90.1076
53	6249 Canal Boulevard	New Orleans	LA	70124	30.00381	-90.1078
54	4516 Chantilly Drive	New Orleans	LA	70126	30.01368	-90.0058
55	2707 Charlres Street #5	New Orleans	LA	70117	29.97006	-90.0296
56	2441 Chartres Street	New Orleans	LA	70117	29.96388	-90.0535
57	2707 Chartres Street #5	New Orleans	LA	70117	29.96374	-90.0507
58	2821 Chippewa Street	New Orleans	LA	70115	29.9227	-90.0802
59	2822 Chippewa Street	New Orleans	LA	70115	29.92253	-90.0801
60	2830 Chippewa Street	New Orleans	LA	70115	29.92246	-90.0802
61	2821 Chippewa Street	New Orleans	LA	70115	29.9227	-90.0802
62	2816 Chippewa Street	New Orleans	LA	70115	29.92257	-90.08
63	2814 Chippewa Street	New Orleans	LA	70115	29.92259	-90.08
64	400 City Park Avenue	New Orleans	LA	70119	29.98334	-90.1062
65	3326 Clermont Drive	New Orleans	LA	70122	29.99237	-90.0525
66	7225 Cohn Street	New Orleans	LA	70118	29.94802	-90.1187
67	2733 D'Abadie Street	New Orleans	LA	70119	29.98185	-90.0751
68	2807 D'Abadie Street	New Orleans	LA	70119	29.98229	-90.0757
69	1137 Dale Court	New Orleans	LA	70124	29.99264	-90.105
70	2340 Dauphine Street	New Orleans	LA	70117	29.9656	-90.0548
71	2329 Dauphine Street	New Orleans	LA	70117	29.96578	-90.055
72	2325 Dauphine Street	New Orleans	LA	70117	29.96577	-90.055
73	2021 Dauphine Street	New Orleans	LA	70116	29.96554	-90.0588
74	3317 Dauphine Street	New Orleans	LA	70117	29.96391	-90.0423
75	5740 Dauphine Street	New Orleans	LA	70117	29.95748	-90.0149
76	3200 DeSoto Street	New Orleans	LA	70119	29.97876	-90.085

77	2856 Dryades Street	New Orleans	LA	70115	29.93295	-90.0886
78	3208 Dumaine Street	New Orleans	LA	70119	29.97584	-90.0872
79	85 East Park Place	New Orleans	LA	70124	29.99176	-90.103
80	101 East Park Place	New Orleans	LA	70124	29.99192	-90.103
81	100 East Park Place	New Orleans	LA	70124	29.9918	-90.1032
82	96 East Park Place	New Orleans	LA	70124	29.99177	-90.1032
83	4678 Eastern	New Orleans	LA	70122	30.00684	-90.0468
84	91 EastPark	New Orleans	LA	70124	30.00511	-90.1043
85	101 Eastview Drive	New Orleans	LA	70128	30.0471	-89.9482
86	505 Edenborn Avenue	Metairie	LA	70001	29.97836	-90.163
87	7191 Edgefield Drive	New Orleans	LA	70128	30.04871	-89.9527
88	7050 Edgefield Drive	New Orleans	LA	70128	30.05774	-89.949
89	7075 Edgefield Drive	New Orleans	LA	70128	30.05774	-89.9488
90	7131 Edgefield Drive	New Orleans	LA	70128	30.05904	-89.9499
91	7150 Edgefield Drive	New Orleans	LA	70128	30.05847	-89.9496
92	405 Elmira Avenue	New Orleans	LA	70114	29.95195	-90.0469
93	736 Elmira Avenue	New Orleans	LA	70114	29.94826	-90.047
94	2176 Esplanade Avenue	New Orleans	LA	70119	29.97297	-90.0739
95	2011 Esplanade Avenue	New Orleans	LA	70119	29.97202	-90.0721
96	3036 Esplanade Avenue	New Orleans	LA	70119	29.97896	-90.0826
97	1431 Euterpe Street	New Orleans	LA	70130	29.93648	-90.0742
98	3930 Fairmont	New Orleans	LA	70122	29.99723	-90.0567
99	1635 Fern Street	New Orleans	LA	70118	29.94898	-90.1247
100	2436 Fern Street	New Orleans	LA	70125	29.95502	-90.1185
101	875 Filmore Avenue	New Orleans	LA	70124	30.01201	-90.1034
102	883 Filmore Avenue	New Orleans	LA	70124	30.01199	-90.1032
103	878 Filmore Avenue	New Orleans	LA	70124	30.01182	-90.1033
104	3627 First Street	New Orleans	LA	70125	29.94933	-90.0949
105	3614 First Street	New Orleans	LA	70125	29.94913	-90.0949
106	3631 First Street	New Orleans	LA	70125	29.94936	-90.0949
107	4128 Fontainebleau	New Orleans	LA	70125	29.949	-90.1048
108	1025 Fourth Street	New Orleans	LA	70130	29.92611	-90.0811
109	915 Franklin Avenue	New Orleans	LA	70117	29.96687	-90.0507
110	1241 Frenchmen Street	New Orleans	LA	70116	29.9699	-90.0581
111	4700 Freret Street	New Orleans	LA	70115	29.93489	-90.1064
112	7433 Freret Street	New Orleans	LA	70118	29.94176	-90.1259
113	2205 Gayoso	New Orleans	LA	70125	29.94861	-90.1059
114	6725 Gen. Haig Street	New Orleans	LA	70124	30.00511	-90.1043
115	6770 Gen. Haig Street	New Orleans	LA	70124	30.00511	-90.1043
116	6870 Gen. Haig Street	New Orleans	LA	70124	30.00511	-90.1043
117	6817 Gen. Haig Street	New Orleans	LA	70124	30.00511	-90.1043
118	1924 Gen. Taylor Street	New Orleans	LA	70115	29.92553	-90.1024
119	5626 General Diza Street	New Orleans	LA	70124	29.99172	-90.1067
120	2301 Gov. Nichols Street	New Orleans	LA	70119	29.97595	-90.0869

121	3229 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
122	3202 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
123	3213 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
124	3330 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
125	3334 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
126	3310 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
127	3301 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
128	3242 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
129	3232 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
130	3221 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
131	3324 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
132	3336 Grand Route St. John	New Orleans	LA	70119	29.97595	-90.0869
133	625 Hagan Avenue	New Orleans	LA	70119	29.97409	-90.0902
134	625 Hagan Avenue	New Orleans	LA	70119	29.97409	-90.0902
135	625 Hagan Avenue	New Orleans	LA	70119	29.97409	-90.0902
136	730 Hidalgo Street	New Orleans	LA	70124	29.99052	-90.1091
137	506 Hidalgo Street	New Orleans	LA	70124	30.00511	-90.1043
138	812 Hidalgo Street	New Orleans	LA	70124	29.99039	-90.1076
139	13925 Intrepid Street	New Orleans	LA	70129	30.06129	-89.9256
140	13917 Intrepid Street	New Orleans	LA	70129	30.06106	-89.9258
141	1717.5 Jackson Avenue	New Orleans	LA	70113	29.93538	-90.0816
142	1739 Jackson Avenue	New Orleans	LA	70113	29.93575	-90.0819
143	933 Jackson Avenue	New Orleans	LA	70130	29.92832	-90.0755
144	1236 Jackson Avenue	New Orleans	LA	70130	29.93063	-90.0778
145	2533 Jefferson Avenue	New Orleans	LA	70115	29.93758	-90.1104
146	1022 Jefferson Avenue	New Orleans	LA	70115	29.9222	-90.1148
147	2616 Jefferson Avenue	New Orleans	LA	70115	29.93804	-90.1106
148	1128 Josephine Street	New Orleans	LA	70130	29.93045	-90.076
149	4419 Knight Drive	New Orleans	LA	70127	30.01557	-89.9824
150	14151 Knightway Drive	New Orleans	LA	70128	30.05868	-89.9483
151	4462 Lafaye Street	New Orleans	LA	70122	30.00379	-90.0484
152	6846 Lake Willow Drive	New Orleans	LA	70126	30.03022	-89.9973
153	4100 Laurel Street	New Orleans	LA	70115	29.91894	-90.0978
154	3800 Laurel Street	New Orleans	LA	70115	29.91938	-90.0936
155	2001 Leon C. Simon Drive	New Orleans	LA	70122	30.02398	-90.0657
156	743 Longue Place	New Orleans	LA	70124	30.00511	-90.1043
157	738 Longue Place	New Orleans	LA	70124	30.00511	-90.1043
158	6530 Louis XIV Street	New Orleans	LA	70124	30.0093	-90.1089
159	725 Louisa Street	New Orleans	LA	70117	29.96331	-90.0435
160	939 Louisa Street	New Orleans	LA	70117	29.96538	-90.0429
161	20434 Lucrino Rd	New Orleans	LA	70129	30.07662	-89.8678
162	4725 Magazine Street	New Orleans	LA	70115	29.92057	-90.1053
163	4018 Magazine Street	New Orleans	LA	70115	29.92104	-90.097
164	4201 Magazine Street	New Orleans	LA	70115	29.92108	-90.0991

165	805 Mandeville Street	New Orleans	LA	70117	29.96578	-90.0541
166	3741 Mansfield Avenue	New Orleans	LA	70131	29.91429	-89.9825
167	4535 Marais Street	New Orleans	LA	70117	29.96538	-90.0295
168	3016 Marais Street	New Orleans	LA	70117	29.96876	-90.0453
169	4724 Mark Twain Street	New Orleans	LA	70126	30.00932	-90.0362
170	6707 Marshall Foch	New Orleans	LA	70124	30.01197	-90.1028
171	6726 Marshall Foch	New Orleans	LA	70124	30.01236	-90.1029
172	6701 Marshall Foch	New Orleans	LA	70124	30.01186	-90.1028
173	19 Maryland Drive	New Orleans	LA	70124	29.98056	-90.1242
174	1128 Melpomene Street	New Orleans	LA	70130	29.93726	-90.072
175	144 Middle Park Place	New Orleans	LA	70124	29.99133	-90.1037
176	164 Middle Park Place	New Orleans	LA	70124	29.99175	-90.1039
177	7027 Milne	New Orleans	LA	70124	30.01876	-90.1106
178	719 Montegut Street	New Orleans	LA	70117	29.96403	-90.0471
179	719 Montegut Street	New Orleans	LA	70117	29.96403	-90.0471
180	731 Montegut Street	New Orleans	LA	70117	29.96415	-90.0471
181	723 Montegut Street	New Orleans	LA	70117	29.96407	-90.0471
182	741 Montegut Street	New Orleans	LA	70117	29.96425	-90.047
183	1129 Montegut Street	New Orleans	LA	70117	29.96837	-90.0458
184	1037 Montegut Street	New Orleans	LA	70117	29.96722	-90.0461
185	238 Morgan Street	New Orleans	LA	70114	29.95386	-90.0543
186	738 Moss Street	New Orleans	LA	70119	29.97595	-90.09
187	618 Moss Street	New Orleans	LA	70119	29.97428	-90.0906
188	948 Mouton Street	New Orleans	LA	70124	30.0152	-90.1007
189	4620 Music Street	New Orleans	LA	70122	30.00534	-90.0543
190	6338 Music Street	New Orleans	LA	70122	30.02389	-90.0555
191	4650 Music Street	New Orleans	LA	70122	30.00588	-90.0543
192	315 North Bernadotte	New Orleans	LA	70119	29.98127	-90.1062
193	318 North Bernadotte	New Orleans	LA	70119	29.98118	-90.1061
194	841 North Broad Street	New Orleans	LA	70119	29.97178	-90.0822
195	1433 North Derbigny	New Orleans	LA	70116	29.97082	-90.0689
196	1201 North Dorgenois Street	New Orleans	LA	70119	29.97371	-90.0782
197	1728 North Gayoso Street	New Orleans	LA	70119	29.98333	-90.076
198	1307 North Miro Street	New Orleans	LA	70119	29.97253	-90.0745
199	1117 North Miro Street	New Orleans	LA	70119	29.97111	-90.0757
200	1129 North Miro Street	New Orleans	LA	70119	29.97119	-90.0757
201	84 North Park Place	New Orleans	LA	70124	29.99227	-90.1047
202	59 North Park Place	New Orleans	LA	70124	29.9924	-90.1048
203	1464 North Prieur	New Orleans	LA	70116	29.97236	-90.0701
204	321 North Rendon	New Orleans	LA	70119	29.97122	-90.0913
205	621 North Rendon	New Orleans	LA	70119	29.97346	-90.0893
206	1032 North Robertson	New Orleans	LA	70116	29.96599	-90.07
207	2448 North Villere Street	New Orleans	LA	70117	29.97187	-90.0509
208	1426 Napoleon Avenue	New Orleans	LA	70115	29.92521	-90.1021

209	1626 Napoleon Avenue	New Orleans	LA	70115	29.92682	-90.1023
210	3030 Nashville	New Orleans	LA	70125	29.94332	-90.1119
211	3520 Nashville	New Orleans	LA	70125	29.94771	-90.1104
212	8205 Nelson Street	New Orleans	LA	70118	29.95762	-90.1206
213	8220 Neron Place	New Orleans	LA	70118	29.95608	-90.1227
214	2539 Octavia Street	New Orleans	LA	70115	29.9376	-90.1116
215	2601 Octavia Street	New Orleans	LA	70115	29.93804	-90.1114
216	544 Olivier Street	New Orleans	LA	70114	29.9504	-90.0498
217	500-02 Opelousas Avenue	New Orleans	LA	70114	29.94882	-90.0505
218	2601 Palmer	New Orleans	LA	70118	29.94138	-90.1153
219	3522 Palmyra	New Orleans	LA	70119	29.96915	-90.0969
220	524 Park Boulevard	New Orleans	LA	70114	29.9398	-90.0503
221	1717 Pauger St.	New Orleans	LA	70117	29.96749	-90.0602
222	221 Pelican Avenue	New Orleans	LA	70114	29.95134	-90.054
223	520 Pelican Avenue	New Orleans	LA	70114	29.95333	-90.0509
224	822 Philip Street	New Orleans	LA	70130	29.92668	-90.0759
225	1222 Philip Street	New Orleans	LA	70130	29.9299	-90.0787
226	1503 Pine Street	New Orleans	LA	70118	29.94506	-90.1217
227	470 Pine Street	New Orleans	LA	70118	29.93606	-90.129
228	7021 Pinebrook Drive	New Orleans	LA	70128	30.05846	-89.9454
229	7110 Pinebrook Drive	New Orleans	LA	70128	30.059	-89.9461
230	7915 Plum Street	New Orleans	LA	70118	29.94682	-90.1273
231	929 Port Street	New Orleans	LA	70117	29.96681	-90.0497
232	8215 Pritchard	New Orleans	LA	70118	29.96053	-90.1176
233	7049 Queenway Drive	New Orleans	LA	70128	30.04871	-89.9527
234	7040 Queenway Drive	New Orleans	LA	70128	30.04871	-89.9527
235	7000 Ridgefield Drive	New Orleans	LA	70128	30.05919	-89.9473
236	7161 Ridgefield Drive	New Orleans	LA	70128	30.05926	-89.9471
237	3393 Roger Williams	New Orleans	LA	70119	29.98996	-90.0824
238	2438 Royal Street	New Orleans	LA	70117	29.96473	-90.0531
239	2446 Royal Street	New Orleans	LA	70117	29.96474	-90.0529
240	930 Rue St. Ann	New Orleans	LA	70116	29.96796	-90.0645
241	5401 South Claiborne Avenue	New Orleans	LA	70125	29.94175	-90.1095
242	4312 South Dorgenois	New Orleans	LA	70125	29.94843	-90.1032
243	3824 South Post Oak Avenue	New Orleans	LA	70131	29.90698	-89.996
244	4436 South Rocheblave	New Orleans	LA	70125	29.94733	-90.1047
245	2409 South Tonti	New Orleans	LA	70125	29.94984	-90.0954
246	2401 South Tonti	New Orleans	LA	70125	29.94988	-90.0954
247	11 South Park Place	New Orleans	LA	70124	29.9898	-90.1033
248	624 Spain Street	New Orleans	LA	70117	29.96407	-90.053
249	3035 St. Ann Street	New Orleans	LA	70119	29.97595	-90.0869
250	2401 St. Anne	New Orleans	LA	70119	29.97595	-90.0869

251	5571 St. Anthony	New Orleans	LA	70122	30.01016	-90.0643
252	5711 St. Anthony	New Orleans	LA	70122	30.01016	-90.0643
253	5713 St. Anthony	New Orleans	LA	70122	30.01016	-90.0643
254	5701 St. Anthony	New Orleans	LA	70122	30.01016	-90.0643
255	1359 St. Bernard Avenue	New Orleans	LA	70116	29.96796	-90.0645
256	1055 St. Charles Avenue	New Orleans	LA	70130	29.94266	-90.0731
257	2919 St. Charles Avenue	New Orleans	LA	70115	29.93024	-90.0876
258	1225 St. Claude	New Orleans	LA	70116	29.96796	-90.0645
259	927 St. Ferdinand	New Orleans	LA	70117	29.97006	-90.0296
260	3210 St. Peter	New Orleans	LA	70119	29.97595	-90.0869
261	1615 St. Philip	New Orleans	LA	70116	29.96796	-90.0645
262	1830 St. Roch Avenue	New Orleans	LA	70117	29.97006	-90.0296
263	4724 St. Roch Avenue	New Orleans	LA	70122	30.01016	-90.0643
264	2831 St. Thomas Street	New Orleans	LA	70115	29.92553	-90.1024
265	3014 St. Thomas Street	New Orleans	LA	70115	29.92553	-90.1024
266	3351 State St. Drive	New Orleans	LA	70125	29.94735	-90.1117
267	4321 State St. Drive	New Orleans	LA	70125	29.95568	-90.1087
268	3361 State St. Drive	New Orleans	LA	70125	29.94744	-90.1117
269	3365 State St. Drive	New Orleans	LA	70125	29.94748	-90.1117
270	3357 State St. Drive	New Orleans	LA	70125	29.94741	-90.1117
271	3345 State St. Drive	New Orleans	LA	70125	29.9473	-90.1117
272	3339 State St. Drive	New Orleans	LA	70125	29.94725	-90.1117
273	4321 State St. Drive	New Orleans	LA	70125	29.95568	-90.1087
274	4125 State St. Drive	New Orleans	LA	70125	29.95346	-90.1096
275	5366 Stillwater Drive	New Orleans	LA	70128	30.03271	-89.9545
276	5356 Stillwater Drive	New Orleans	LA	70128	30.03262	-89.9545
277	15 Sugarberry Place	New Orleans	LA	70131	29.90681	-89.9631
278	3022 Teers Street	New Orleans	LA	70126	30.01519	-90.0198
279	3223 Toulouse Street	New Orleans	LA	70119	29.97378	-90.09
280	3158 Toulouse Street	New Orleans	LA	70119	29.97282	-90.0889
281	3206 Toulouse Street	New Orleans	LA	70119	29.9733	-90.0896
282	929 Touro Street	New Orleans	LA	70117	29.96671	-90.059
283	2601 Tulane Avenue, 7th Floor	New Orleans	LA	70119	29.9612	-90.0889
284	1317 Tupelo St.	New Orleans	LA	70117	29.96187	-90.0101
285	2521 Upperline Street	New Orleans	LA	70115	29.93511	-90.1072
286	1725 Upperline Street	New Orleans	LA	70115	29.92736	-90.1076
287	5441 Urquhart Street	New Orleans	LA	70117	29.96369	-90.0172
288	3118 Ursulines Avenue	New Orleans	LA	70119	29.97704	-90.0848
289	2624 Ursulines Avenue	New Orleans	LA	70119	29.97304	-90.0791
290	2508 Ursulines Avenue	New Orleans	LA	70119	29.97208	-90.0777
291	2610 Ursulines Avenue	New Orleans	LA	70119	29.97291	-90.0789
292	2615 Ursulines Avenue	New Orleans	LA	70119	29.97315	-90.0788
293	2539 Ursulines Avenue	New Orleans	LA	70119	29.97252	-90.0779

294	2637 Ursulines Avenue	New Orleans	LA	70119	29.97336	-90.0791
295	2527 Ursulines Avenue	New Orleans	LA	70119	29.97242	-90.0778
296	2625 Ursulines Avenue	New Orleans	LA	70119	29.97324	-90.079
297	2021 Ursulines Avenue	New Orleans	LA	70116	29.96931	-90.0733
298	1531 Ursulines Avenue	New Orleans	LA	70116	29.96629	-90.069
299	2651 Ursulines Avenue	New Orleans	LA	70119	29.97349	-90.0793
300	2630 Ursulines Avenue	New Orleans	LA	70119	29.9731	-90.0792
301	2633 Ursulines Avenue	New Orleans	LA	70119	29.97332	-90.0791
302	2644 Ursulines Avenue	New Orleans	LA	70119	29.97323	-90.0794
303	1803 Ursulines Avenue	New Orleans	LA	70116	29.968	-90.0714
304	2656 Ursulines Avenue	New Orleans	LA	70119	29.97334	-90.0796
305	4008 Vendome Place	New Orleans	LA	70125	29.95123	-90.1087
306	6049 Vermillion Boulevard	New Orleans	LA	70122	30.02119	-90.0621
307	6376 Vicksburg Street	New Orleans	LA	70124	30.00627	-90.1067
308	4230 Vincennes Place	New Orleans	LA	70125	29.95538	-90.1084
309	29 West Park Place	New Orleans	LA	70124	29.99039	-90.1037
310	18 West Park Place	New Orleans	LA	70124	29.98924	-90.1034
311	46 West Park Place	New Orleans	LA	70124	29.99113	-90.1043
312	21 West Robert E. Lee	New Orleans	LA	70124	30.00511	-90.1043
313	5302 Warrington Drive	New Orleans	LA	70122	30.01198	-90.0692
314	5841 Waterford Boulevard	New Orleans	LA	70127	30.0365	-89.9656
315	7040 Whitmore Place	New Orleans	LA	70128	30.05819	-89.9484
316	6077 Wildair Drive	New Orleans	LA	70122	30.02112	-90.0674
317	5708 Wildair Drive	New Orleans	LA	70122	30.01651	-90.0671
318	5169 Wildair Drive	New Orleans	LA	70122	30.01063	-90.0668
319	6005 Wildair Drive	New Orleans	LA	70122	30.01912	-90.0672
320	5768 Wildair Drive	New Orleans	LA	70122	30.01702	-90.0672
321	1900 Wildair Drive	New Orleans	LA	70122	30.00941	-90.0687
322	6005 Wildair Drive	New Orleans	LA	70122	30.01912	-90.0672
323	6013 Wilton Drive	New Orleans	LA	70122	30.01939	-90.0664
324	5720 Wilton Drive	New Orleans	LA	70122	30.01666	-90.0664
325	5749 Wingate Drive	New Orleans	LA	70122	30.01681	-90.0678
326	6020 Wingate Drive	New Orleans	LA	70122	30.01922	-90.0682
327	6060 Wingate Drive	New Orleans	LA	70122	30.01976	-90.0682
328	6056 Wingate Drive	New Orleans	LA	70122	30.01971	-90.0682
329	6048 Wingate Drive	New Orleans	LA	70122	30.0196	-90.0682
330	6052 Wingate Drive	New Orleans	LA	70122	30.01965	-90.0682
331	6000 Wingate Drive	New Orleans	LA	70122	30.01894	-90.0682
332	11284 Winrock Drive	New Orleans	LA	70128	30.03746	-89.9549
333	5941 Wright Road	New Orleans	LA	70128	30.03877	-89.9655
334	6739 Wuerpel Street	New Orleans	LA	70124	30.01337	-90.1124
335	3018 Dryades Street	New Orleans	Louisiana	70015	29.93209	-90.0901
336	3028 Dryades Street	New Orleans	Louisiana	70015	29.93204	-90.0902
337	1623 7th Street	New Orleans	Louisiana	70015	29.93003	-90.0883

338	2036 7th Street	New Orleans	Louisiana	70015	29.9333	-90.0909
339	2037 7th Street	New Orleans	Louisiana	70015	29.93341	-90.0907
340	2038 7th Street	New Orleans	Louisiana	70015	29.93331	-90.0909
341	2041 7th Street	New Orleans	Louisiana	70015	29.93344	-90.0908
342	2136 7th Street	New Orleans	Louisiana	70015	29.93411	-90.0915
343	2238 7th Street	New Orleans	Louisiana	70015	29.93493	-90.0921
344	1937 6th Street	New Orleans	Louisiana	70015	29.93305	-90.0893
345	1023 6th Street	New Orleans	Louisiana	70015	29.92488	-90.0832
346	3213 S. Saratoga Street	New Orleans	Louisiana	70015	29.93356	-90.0919
347	3205 S. Saratoga Street	New Orleans	Louisiana	70015	29.93358	-90.0919
348	3100 Fortin Street	New Orleans	Louisiana	70119	29.9815	-90.0832
349	3102 Fortin Street	New Orleans	Louisiana	70119	29.9815	-90.0832
350	3106 Fortin Street	New Orleans	Louisiana	70119	29.9815	-90.0833
351	3108 Fortin Street	New Orleans	Louisiana	70119	29.98151	-90.0833
352	4312 S. Tonti Street	New Orleans	Louisiana	70125	29.94659	-90.103
353	4320 S. Tonti Street	New Orleans	Louisiana	70125	29.94658	-90.1031
354	4322 S. Tonti Street	New Orleans	Louisiana	70125	29.94658	-90.1031
355	4323 S. Tonti Street	New Orleans	Louisiana	70125	29.94676	-90.1031
356	4321 S. Tonti Street	New Orleans	Louisiana	70125	29.94676	-90.1031
357	5356 Stillwater Drive	New Orleans	Louisiana	70128	30.03262	-89.9545
358	729 Henry Clay	New Orleans	Louisiana	70118	29.92253	-90.1246
359	737 Henry Clay	New Orleans	Louisiana	70118	29.9226	-90.1246
360	314 Henry Clay	New Orleans	Louisiana	70118	29.91881	-90.1265
361	320 Henry Clay	New Orleans	Louisiana	70118	29.91887	-90.1265
362	6050 Constance	New Orleans	Louisiana	70118	29.9215	-90.1228
363	5302 Warrington	New Orleans	Louisiana	70122	30.01198	-90.0692
364	5741 Wingate	New Orleans	Louisiana	70122	30.01675	-90.0678
365	5745 Wingate	New Orleans	Louisiana	70122	30.01678	-90.0678
366	6019 Wingate	New Orleans	Louisiana	70122	30.0192	-90.068
367	6065 Wingate	New Orleans	Louisiana	70122	30.01983	-90.068
368	5713 Wildair	New Orleans	Louisiana	70122	30.01656	-90.067
369	6030 Wildair	New Orleans	Louisiana	70122	30.0198	-90.0674
370	6070 Wildair	New Orleans	Louisiana	70122	30.02091	-90.0675
371	6077 Wildair	New Orleans	Louisiana	70122	30.02112	-90.0674
372	5517 Wilton Drive	New Orleans	Louisiana	70122	30.01445	-90.066
373	5712 Wilton Drive	New Orleans	Louisiana	70122	30.01659	-90.0664
374	6009 Vermillon Boulevard	New Orleans	Louisiana	70122	30.02174	-90.0622
375	6006 Pasteur Boulevard	New Orleans	Louisiana	70124	30.01931	-90.0635
376	1531 Dumaine	New Orleans	Louisiana	70116	29.96467	-90.0705
377	1527 Dumaine	New Orleans	Louisiana	70116	29.96465	-90.0704
378	1525 Dumaine	New Orleans	Louisiana	70116	29.96464	-90.0704
379	1521 Dumaine	New Orleans	Louisiana	70116	29.96461	-90.0704
380	1519 Dumaine	New Orleans	Louisiana	70116	29.9646	-90.0704
381	1517 Dumaine	New Orleans	Louisiana	70116	29.96459	-90.0704

382	1511 Dumaine	New Orleans	Louisiana	70116	29.96456	-90.0703
383	1509 Dumaine	New Orleans	Louisiana	70116	29.96455	-90.0703
384	1507 Dumaine	New Orleans	Louisiana	70116	29.96454	-90.0703
385	1505 Dumaine	New Orleans	Louisiana	70116	29.96453	-90.0703
386	1501 Dumaine	New Orleans	Louisiana	70116	29.96451	-90.0702
387	1524 Dumaine	New Orleans	Louisiana	70116	29.96449	-90.0705
388	1522 Dumaine	New Orleans	Louisiana	70116	29.96447	-90.0705
389	1518 Dumaine	New Orleans	Louisiana	70116	29.96445	-90.0705
390	1514 Dumaine	New Orleans	Louisiana	70116	29.96443	-90.0704
391	1506 Dumaine	New Orleans	Louisiana	70116	29.96439	-90.0704
392	1504 Dumaine	New Orleans	Louisiana	70116	29.96438	-90.0704
393	1501 Dumaine	New Orleans	Louisiana	70116	29.96451	-90.0702
394	2003 Dumaine	New Orleans	Louisiana	70116	29.96753	-90.0746
395	1937 Dumaine	New Orleans	Louisiana	70116	29.96714	-90.0741
396	1938 Dumaine	New Orleans	Louisiana	70116	29.967	-90.0742
397	2024 Dumaine	New Orleans	Louisiana	70116	29.96751	-90.0749
398	2023 Dumaine	New Orleans	Louisiana	70116	29.96765	-90.0748
399	2021 Dumaine	New Orleans	Louisiana	70116	29.96763	-90.0748
400	2031 Dumaine	New Orleans	Louisiana	70116	29.96769	-90.0749
401	826 N Robinson	New Orleans	Louisiana	70116	29.96796	-90.0645
402	832 N Robinson	New Orleans	Louisiana	70116	29.96796	-90.0645
403	842 N Robinson	New Orleans	Louisiana	70116	29.96796	-90.0645
404	1616 Ursuline	New Orleans	Louisiana	70116	29.96691	-90.0702
405	1618 Ursuline	New Orleans	Louisiana	70116	29.96691	-90.0702
406	1614 Ursuline	New Orleans	Louisiana	70116	29.9669	-90.0702
407	1612 Ursuline	New Orleans	Louisiana	70116	29.9669	-90.0702

Examples of Permits Requested from City of New Orleans from Parkway Partners

Project Title: ReLeaf New Orleans

Organization Name: Parkway Partners Program

Trees to be Planted: on street, in home landscapes and schoolyards

Species Name	Size	Number of Trees
Holly	1 ½ caliper 10gal.	50
Fringe	1 ½" 10 gal.	50
Sweet bay	1 ½" 10 gal.	100
Yaupon	1 ½" 10 gal.	50
Silver bell	1 ½" 10 gal.	30
Iron wood (Beech)	1 ½" 10 gal.	10
Spruce	1 ½" 5 gal.	10
Japanese Magnolia	1 ½" 5 gal.	50
Pistachio	1 ½" 5 gal.	50
Red Bud	1 ½" 5 gal.	50

Total Trees: 450

NOTE OF JUSTIFICATION: These are all tree species that are suitable for street planting on grass areas 3' or more between the sidewalk and the street as identified by the master plan of the New Orleans Department of Parks and Parkways. Parkway Partners proposes replacing trees destroyed by the hurricane on a tree for tree basis as originally planted in landscape design.

Project Title: ReLeaf New Orleans

Organization Name: Parkway Partners Program

Trees to be Planted: Neutral Ground Trees

Species Name	Size	Number of Trees
Live Oak	2 ½" 40 gal.	66
Willow Oak	2 ½" 40 gal.	16
Magnolia	2 ½" 40 gal.	107
Cypress	2 ½" 25 gal.	97
Green Ash	2 ½" 25gal.	22
Holly	2 ½" 25 gal.	124
Fringe	2 ½" 25 gal.	46
Acacia	2 ½" 25 gal.	14
Crepe Myrtle	2 ½" 25 gal.	92
Pistachio	2 ½" 25 gal.	32

Total Trees: 616

NOTE OF JUSTIFICATION: These are all tree species that are replacing lost trees on the neutral grounds as identified by the master plan of the New Orleans Department of Parks and Parkways. Parkway Partners proposes replacing trees destroyed by the hurricane on a tree for tree basis as originally planted in landscape design.

APPENDIX 3

TREMÉ, NEW ORLEANS TREE CANOPY DATA AND ANALYSIS

Introduction

As described in Chapter 4 of this dissertation, my introduction to post-Katrina New Orleans was a result of work I initially engaged in with Cornell University's City and Regional Planning Department in January of 2006. In early 2010, a master's student in Cornell's City and Regional Planning Department named Matthew Mornick approached me and inquired about collaborating with me for his final project. He had read some of my preliminary research reports about trees and tree planting in post Katrina New Orleans, was aware that I was actively seeking assistance in spatial analysis in New Orleans, and expressed interest in assisting me with the technical aspects of GIS based urban canopy analysis and surface area analysis. We worked together collaboratively throughout the project to collect, analyze and manipulate the data, and to develop the following urban tree canopy and surface area analysis in Tremé, New Orleans. This work appears as an appendix in this dissertation, and is not to be considered fully–developed data or research or considered a "paper" as such. It is included because the research activity yielded useful visual products, demonstrated the limitations of certain GIS analytical approaches and techniques, suggested useful further research and associated methods and approaches, and documents a particular method for use in limited, similar applications.

Tremé is a neighborhood of roughly 140 square blocks in downtown New Orleans. As of the 2000 census, there were 8,853 people, 3,429 households, and 2,064 families residing in the neighborhood.[33] Tremé abuts the north side of the French quarter, away from the Mississippi River. Broad Street marks the northern border with Rampart Street to the south, Saint Louis Street on the west and Esplanade Avenue on the east. Claiborne Avenue is the main thoroughfare through the neighborhood. Historically it was a wide, shaded “neutral ground” lined with old and stately live oak trees.

As described in chapter 2 of this dissertation, public green space along Claiborne Avenue was said to have been used as a community gathering place for the area's mostly African-American residents. The construction of an elevated highway through Tremé in the late 1960s is thought to be one of the most controversial developments in New Orleans’ history. Following the construction, parking lots along the freeway replaced grassy areas. The concrete supports for the highway replaced oak trees. Construction of the overpass contributed to the overall decline of Tremé in the 60's and 70's. In 2002, as part of the "Restore the Oaks" art installation, artists painted outer freeway columns to memorialize the live oak trees that once stood on both sides of Claiborne Avenue.[34]

[33] "American FactFinder.” United States Census Bureau. Retrieved 2010-04-29.
[34] Tidball, K. G., M. Krasny, et al. (2010). "Stewardship, Learning, and Memory in Disaster Resilience." *Environmental Education Research* (Special Issue, Resilience in social-ecological systems: The role of learning and education) **16**(5): 341-357.

Without hesitation, in the wake of Hurricane Katrina, Tremé residents began planting trees. Techniques to ensure successful tree plantings permeated among residents. For example, the NGO Parkway Partners trained citizen "Tree Troopers" to aid in the replanting and tree care efforts. Similar to what occurred in the Living Memorials Project, opportunities for cross-site learning were created, as when trained Tree Troopers were called upon to go to other neighborhoods to train additional tree planters.[35]

Chapter 2 of this dissertation poses comprehensive arguments linking the impact of green space on social resilience and overall community well-being, however, one important question remained unanswered: what is the precise relation between the efforts of tree-planting groups and their total impact on the tree canopy in Tremé (or New Orleans more broadly)? More specifically, what is the net effect of all tree-planting initiatives on the urban tree canopy?

Purpose of the Research

The specific purpose of this research was twofold: first to compare Tremé's tree canopy immediately after Hurricane Katrina with the restored tree canopy years later. Orthoimagery provided by USGS from March 2006 served as the basis of the damaged canopy analysis. Orthoimagery provided by USGS from February 2009 served as the most recent (and available) imagery to convey Tremé's current tree canopy status following tree planting efforts. The three-year comparison was thought to potentially be useful to convey the impact of the community –based volunteer tree

[35] *Ibid.*

planters on the overall urban canopy. It would also provide insight for organizing and compelling future tree planting efforts in the region.

The second purpose of this research was to determine how much of Tremé's total surface area consists of tree canopy. Tree canopy in relation to other impervious surfaces illuminates the overall character of the neighborhood, while also providing ratios to compare canopy-to-impervious surfaces in other neighborhoods throughout New Orleans. Consistent with the philosophy of participatory research, this product was to meet requests by the community for this information, and was only peripherally related to our central study aims.

Methods

Urban canopies are the sum of the surface area of the leaves, branches, and stems of trees that cover the ground when viewed from above in and around dense human settlements. Tree concentrations in urban areas provide many direct and indirect benefits, most notably cooling neighborhoods and reducing costs associated with storm water management.[36] To give context to the associated benefits provided by trees in urban areas, especially following a major disaster, the amount of tree canopy must be estimated. [37] Though many third party tools exist for estimating tree canopy, such as i-Tree Canopy, these tools are limited by the fact that they produce *estimates* of land cover types (e.g., tree cover) using aerial images available in Google Maps.

[36] Burden, Dan. (2006). 22 Benefits of Urban Street Trees. http://www.ufei.org/files/pubs/22BenefitsofUrbanStreetTrees.pdf
[37] McKee, Jen and John McGee. Remote Sensing Initiative Supports Local Government Urban Tree Canopy. Policies. *The Virginia Geospatial Newsletter*, Vol 6, no.4. Fall 2008.

Initially, a composite suitability analysis was thought to be the best means to determine what was or was not tree canopy in the Tremé neighborhood. The logic for this approach is that if pixels in an image could be given a weight, the model builder tool in ArcMap would derive a composite suitability analysis where pixels of similar color and texture were categorized in tree canopy and other impervious surfaces. The result would be canopy, roads and buildings falling into distinct categories. This, however, proved to yield varied results that were simply (and disappointingly) inaccurate – areas designated as trees also included rooftops, roads and other green shrubbery.

The alternative approach involved creating new shapefile plots from high-definition raster data that visually distinguish urban tree canopy from other urban areas. Though subjective, this technique (outlined in detail below) proved the most accurate and practical given the scope of the project.

Alternative Techniques

One method to estimate baseline canopy is called digital remote sensing[38] . It involves using a masked geographical boundary of a designated area. Much like how this analysis was conducted, GIS specialists manually classify a multi-spectral (ERDAS) image. The result is an image consisting of different classes which typically include

[38] http://www.forestsforwatersheds.org/storage/DigitalRemoteSensing_FactSheet.pdf

tree canopy, other vegetation, impervious surfaces, and water. More complex tree canopy analyses exist, most of which use complex algorithms to differentiate surface area among high resolution multispectral satellite imagery. These effective methods for calculating urban tree canopies implemented by the USDA Forest Service are arguably more objective; by using models to distinguish tree canopy, they eliminate human error in the selection process, because what one person may perceive as the canopy of a tree may in fact be the shadow cast by the canopy. Such mistakes are "avoided" using algorithms, but are complex, expensive, and utilize software alternatives to ESRI GIS.

Data Sources

The search for data proved to be the greatest obstacle in the analysis. Orthoimagery available online was limited. The two key criteria guiding the search were image resolution and the date images were taken. Abscissa and ordinate resolution (image quality) varied between 3 - 0.3 meters per pixel. Depending on the time of year, total area of tree canopy would either increase (during summer months) or decrease (winter months). Taking these two factors into account, two ortho-images along with residual data from the US Geological Survey (USGS) seamless server provided a basis for the tree canopy comparison and the surface area analysis.[39]

[39] The Raster data for the three images (one from March 2006, two .tiff files for February 2009) were 32479594, 03346673, and 17551496. These images were georeferenced, projected in Universal Transverse Mercator zone 15N.

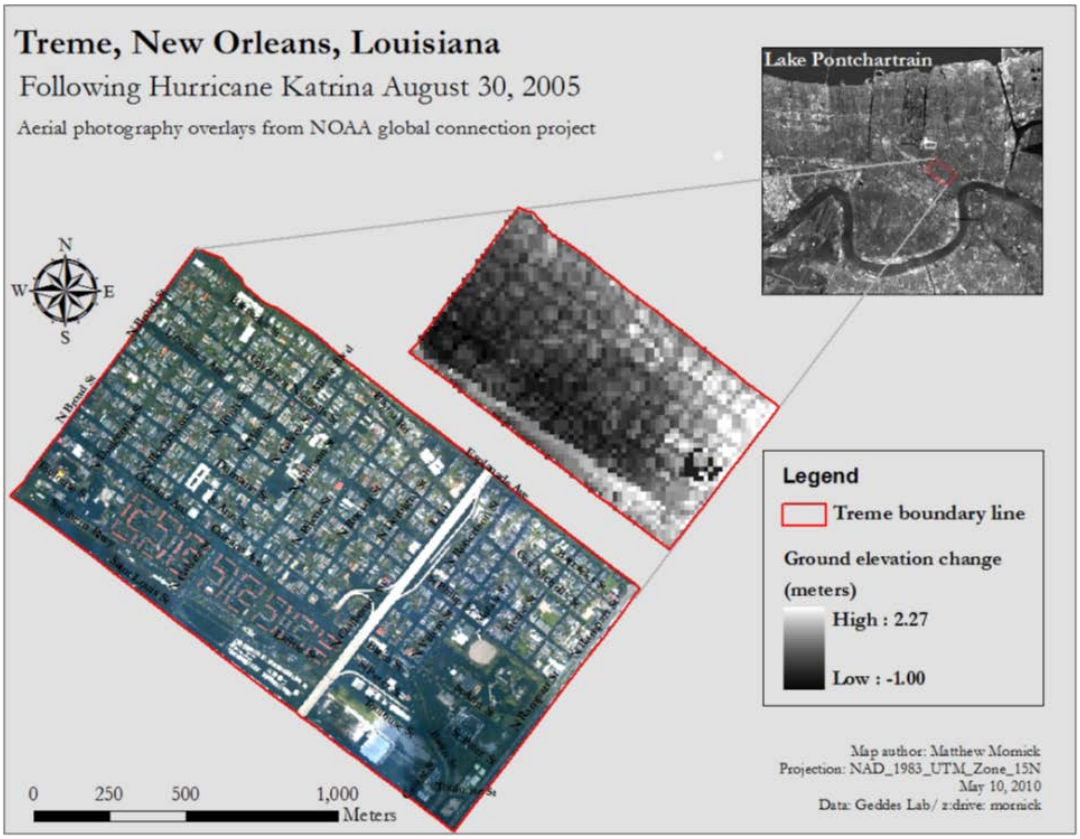
Road information was taken from the Census. The City of New Orleans Planning Department also provided one crucial shapefile consisting of all building footprints of the downtown financial district. Luckily, roughly two-thirds of the total buildings in Tremé were included in the shapefile (the remaining one-third was plotted by hand for both 2006 and 2009).

Nine aerial photographs taken on August 30, 2005 by the National Oceanic and Atmospheric Administration reveal the immediate aftermath following the storm. These nine images were assembled to portray a baseline map of Tremé when the neighborhood was partially inundated with water. National elevation data during that time were also incorporated to portray the variation in ground elevation within Tremé.

Katina-damaged Canopy Analysis

This initial map portrays the aftermath immediately following hurricane Katrina in Tremé, New Orleans. It references Tremé's location in Greater New Orleans, as well as portrays the ground level elevation change in the neighborhood. Referring to the legend, the ground elevation change within Tremé varies roughly three meters. This sheds some insight on low-lying areas most vulnerable to water damage. Comparing maps from 2006 to 2009 in both the following analyses, housing projects (red roofed buildings) along Saint Louis Avenue in the southwest portion of Tremé were removed, most likely due to the extensive water damage.

Figure A3.1



Urban Canopy Comparison and Analysis

The urban canopy analysis involved a two-map comparison of images from March 2006 and February 2009. The maps portray the urban canopy in Tremé neighborhood in downtown New Orleans. The map is divided into nine corridors running perpendicular to Esplanade Avenue and Saint Louis Street. The nine corridors allow comparison on a street by street basis. Volunteer tree planting organizations could potentially see the impact of their efforts within a specific corridor. Furthermore, the

map may guide future tree planting efforts and grant opportunities in corridors with a low percentage of urban canopy in relation to the total (corridor) area.

Figure A3.2

Damaged Tree Canopy Analysis: Treme, New Orleans, Louisiana

March, 2006

	Corridors	Total area (square meters)	Total canopy area (square meters)	Percent of total area
1	N. Broad St.	196,500.00	14,060.79	7.16%
2	N. Rocheblave St.	254,600.00	31,507.44	12.38%
3	N. Miro St.	221,100.00	22,777.29	10.30%
4	N. Johnson St.	216,400.00	17,401.27	8.04%
5	N. Roman St.	211,100.00	22,585.61	10.70%
6	N. Claiborne Avenue	241,200.00	17,753.87	7.36%
7	N. Villere St.	191,500.00	14,091.90	7.36%
8	Treme St.	182,500.00	18,059.89	9.90%
9	N. Rampart St.	145,100.00	24,308.22	16.75%
Treme total area		**1,860,000.00**	**182,546.27**	**9.81%**

Legend

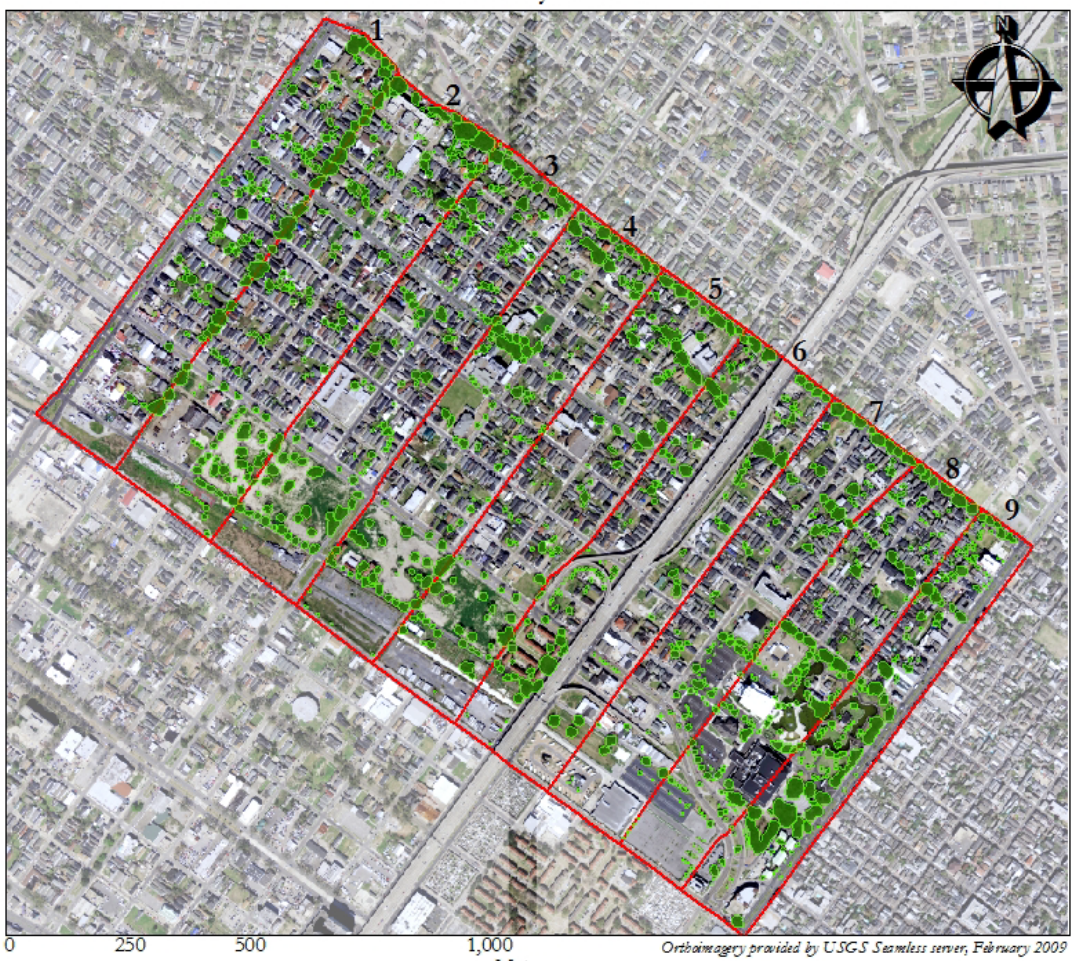
- Tree Canopy
- Corridors
- Roads

Matthew Mornick: Map author
May 10, 2010
NAD_1983_UTM_Zone_15N: Projection
Geddes Lab/ z:drive: mornick: Data

Figure A3.3

Damaged Tree Canopy Analysis: Treme, New Orleans, Louisiana

February 2009



0 250 500 1,000 Meters

Orthoimagery provided by USGS Seamless server, February 2009

	Corridors	Total area (square meters)	Total canopy area (square meters)	Percent of total
1	N. Broad St.	196,500.00	16,437.59	8.37%
2	N. Rocheblave	254,600.00	34,588.72	13.59%
3	N. Miro St.	221,100.00	24,875.33	11.25%
4	N. Johnson St.	216,400.00	21,596.74	9.98%
5	N. Roman St.	211,100.00	22,276.00	10.55%
6	N. Claiborne A	241,200.00	19,223.82	7.97%
7	N. Villere St.	191,500.00	16,193.04	8.46%
8	Treme St.	182,500.00	20,094.97	11.01%
9	N. Rampart St.	145,100.00	25,757.23	17.75%
Treme total area		**1,860,000.00**	**201,043.44**	**10.81%**

Legend

Tree canopy

Corridors

Roads

Matthew Mornick: Map author
May 10, 2010
NAD_1983_UTM_Zone_15N: Projection
Geddes Lab/ z:drive: mornick: Data

Surface Area Analysis

Cities are typically built outwards and upwards with brick, concrete, and asphalt. The ambient air temperature of an urban social-ecological system depends, to a large extent, on its surface characteristics.[40] In general, building materials capture and store heat making urban ambient air temperatures are higher than non-urban areas. Large numbers of people, the increased quantity of impervious surface, the lesser extent of tree canopy, and the emission of heat from homes, buildings, and automobiles further enhances this effect.

This surface area analysis determined the type and total surface area within the Tremé neighborhood. Along with the tree canopy information derived in the tree canopy analysis, two other primary surfaces had to be accounted for: road surfaces and building rooftops. A fourth category was included to account for parking lots, sidewalks, grassy areas and other multifarious surfaces. The first step in the analysis was to identify all road surfaces as well as building rooftops. Together, these ratios helped define the nature of the Tremé neighborhood. They also revealed surface ratios that could be used to extrapolate "heat island" measurements. These measurements describe the air temperature above different surfaces within a city. Because the rooftop and road surfaces were calculated by hand, the analysis only permits a complete area comparison instead of corridor by corridor.

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[40] Espere. Climate in cities: Urban Heat Island. http://www.atmosphere.mpg.de/enid/3rl.html. Accessed 28th April 2010.

Figure A3.4

Treme, New Orleans, Louisiana March 2006

Surface Area Analysis

Legend

- Treme neighborhood
- Building surfaces
- Tree canopy
- Road surfaces
- Roads

Surface	Total Area square meters	Percent of total
Tree canopy	182,546.27	9.81%
Roads	432,800.00	23.27%
Buildings	420,534.21	22.61%
Other	824,140.79	44.31%
Treme total	**1,860,021.27**	**1.00**

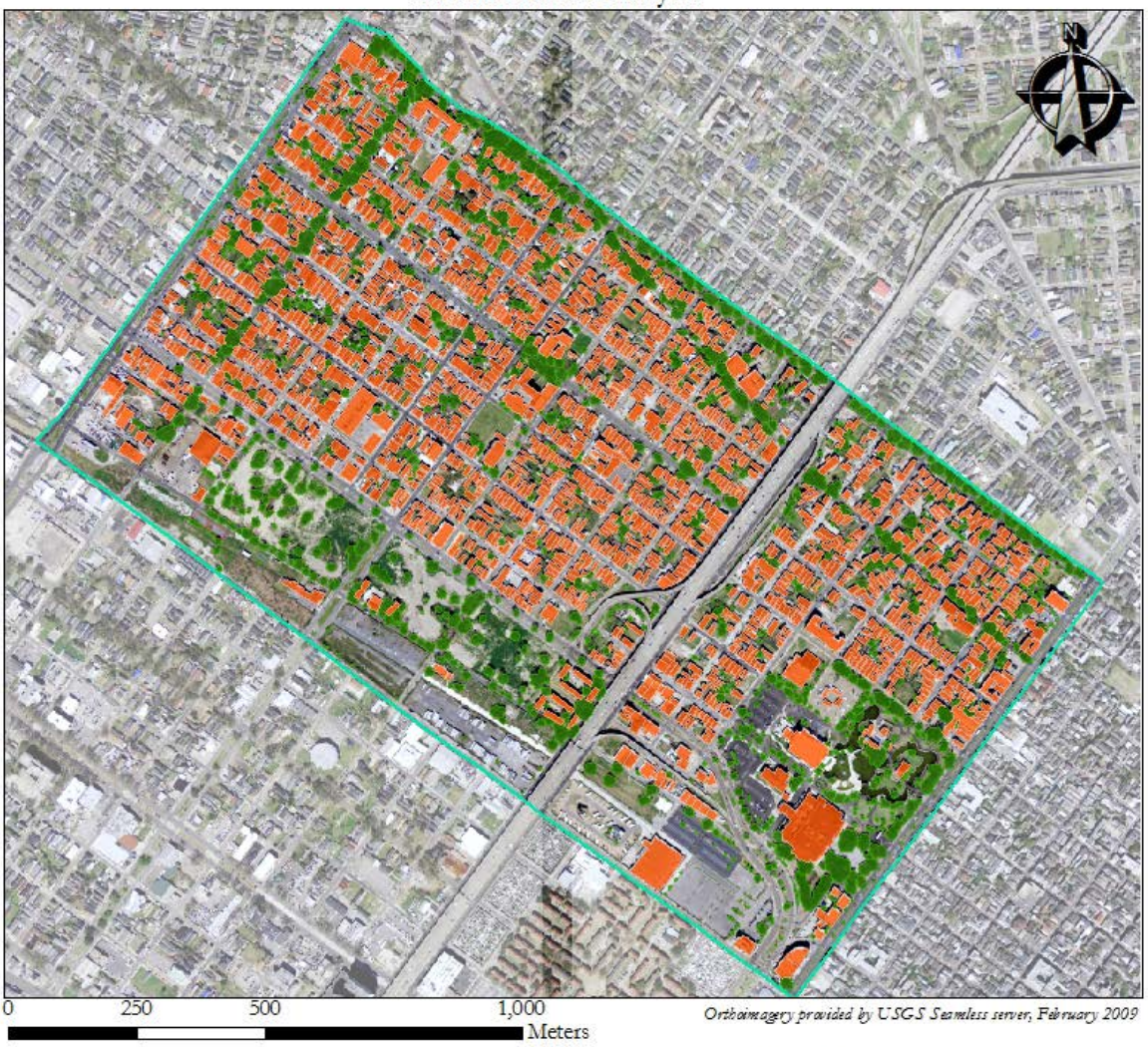
** other includes parking lots, sidewalks, grassy areas, neutral ground, trailers, and trailer campgrounds.*

Matthew Mornick - Projection: NAD_1983_UTM_Zone_15N
Date: May 10, 2010 - Data: Geddes Lab/ z:drive: mornick

Figure A3.5

Treme, New Orleans, Louisiana February 2009

Surface Area Analysis



Legend

- Treme neighborhood
- Building surfaces
- Tree canopy
- Road surfaces
- Roads

Surface	Total Area (square meters)	Percent of total
Tree canopy	201,043.40	10.81%
Roads	421,400.00	22.66%
Buildings	405,347.80	21.79%
Other	832,230.07	44.74%
Treme total	**1,860,021.27**	**1.00**

** other includes parking lots, sidewalks, grassy areas, neutral ground, trailers, and trailer campgrounds.*

Map author: Matthew Mornick - Projection: NAD_1983_UTM_Zone_15N - May 10, 2010 - Data: Geddes Lab/ z:drive: mornick

Results

From March 2006 to February 2009, the tree canopy in Tremé showed a 1% increase. Of the nine corridors, all except the N. Roman Street corridor showed marginal increases in tree canopy cover. This in no way speaks to the efforts of local tree planting initiatives, but rather reflects a reality of limitations of available data (and less than ideal approaches for analysis of the data). The 2006 analysis is based on the first available imagery after Hurricane Katrina, springtime imagery. Tree coverage was in bloom and evident to the viewer's eye. The 2009 analysis, however, involved the only available imagery qualifying under our criteria of "most recent available," imagery taken at the tail-end of winter just before spring. Roughly 80% of the tree cover at this time was clearly discernible. To depict the remainder of the canopy involved following shadows of branches and tree trunks to determine whether a tree in fact existed, and would eventually bloom a canopy. It is also worth noting that when trees are planted by neighborhood associations or other groups who are part of a tree planting community of practice, it may take years before saplings develop canopies that are discernible in aerial photographs. Though all trees were accounted for in this analysis within the Tremé boundary line, comparing data from similar seasons over a longer period of time would result in a more accurate depiction of the Tremé's true tree canopy transformation.

The surface area study revealed that months after the Hurricane Katrina event, tree canopy in Tremé accounted for 182,546.27 square meters of the total surface area of 1,860,021.27 square meters, or 9.81 % of the surface area. After three years, tree

canopy accounted for 201,043.40 square meters, which represents a 10.81 percent of the total surface area of Tremé. This analysis, then, showed a result of a gain of only 1% in tree canopy over a three year period.

Conclusion- Potential Future Work

This analysis is the beginning of potential geospatial research in Tremé and in New Orleans more broadly. Combining the efforts of this analysis with work done on the ground among tree planting groups is crucial. A study demonstrating visually the scope of the urban tree canopy historically, prior to Hurricane Katrina compared to weeks or months after the storm should be relatively straight-forward. Then, demonstrating the successes of multiple years of tree planting by community groups since Hurricane Katrina as restoring or replacing the urban tree canopy would be possible. For example, as tree planting groups conduct training sessions and plant trees, they could also collect highly useful tree data without a substantial increase in effort. Compiling the location (address or GPS coordinates) using existing tool such as the aforementioned i-Tree Canopy[41] , tree type along with water and nutrient requirements would provide much more detailed information for future studies.

As previously mentioned, a more accurate analysis would result if a current canopy status map utilized imagery taken in either March 2010 or 2011 rather than from February 2009. Unfortunately, at the time this research was conducted, the images needed were not available from USGS or other sources. More time in between the two

[41] http://www.itreetools.org/index.php

maps would allow saplings to set canopies. Other areas of analysis could compare per capita income or home property value among various areas in New Orleans to the relative percent of tree canopy. Given the surface area analysis, it would also be interesting to measure air temperatures over the four different surface types at various times of day at various points throughout the year to determine the heat island effect. A comparison among levels of energy consumption at the warmest parts of the year in different corridors in Tremé could shed light on how the number and species of trees (shade) influences energy consumption (cooling devices).

Policy Implications

According to American Forests' *Urban Canopy Analysis of New Orleans' Metropolitan Area (2002)*, local communities should aim for a 40% overall tree canopy; 50% tree canopy in suburban residential; 25% tree canopy in urban residential; 15% tree canopy in the central business district.[42] Besides providing environmental benefits (detailed in the figure below), the earlier chapters of this dissertation make a strong case regarding the well-being of a community: revitalizing local ecology through tree planting creates the space for people to heal after a catastrophic loss, develops strong local bonds, helps in recovery and restoration of sense of place, and becomes a component of SES resilience.

[42] American Forests. *Urban Ecosystem Analysis New Orleans, Louisiana Metropolitan Area*. August 2002.

Table A3.1. Benefits of New Orleans Metropolitan Area Tree Cover.

New Orleans Metropolitan Area Tree Cover Benefits			
	Current Tree Cover (24%)	Modeled at 30% canopy	Modeled at 40% canopy
Air Pollutants Removed Annually (lbs.)	2,854,237	3,537,126	4,716,169
Air Pollutants Removed Annually ($)	$7,103,173	$8,802,639	$11,736,852
Stormwater Mitigated (total cubic feet)	370,500,836	409,553,346	431,250,928
Stormwater Mitigated (total $)	$741,001,672	$819,106,692	$862,501,856
Carbon Stored (total tons)	1,291,700	1,600,700	2,134,300
Carbon Sequestered Annually (tons)	10,000	12,400	16,600

Table from the American Forests 2002 study.

Roughly 10% of Tremé's total surface area is occupied by tree cover. If the American Forests organization calls for a minimum of 25% tree canopy in urban residential areas, Tremé is currently below the recommendations. From the findings in this analysis, Tremé and similar areas throughout New Orleans are top candidates to pursue and receive support to launch a large-scale tree planting initiative. Thanks to the efforts of the tree planting community of practice in post-Katrina New Orleans, tree planting efforts were recognized and recently secured government funding for additional tree planting, an indicator of the efficacy of the trees, the tree planters, and of tree planting in the New Orleans SES.

Coda

Two years after this study was conducted, and after conversations with U.S. Forest Service colleagues at the Northern Research Unit and the Urban Field Station in NYC about my frustrations with both the available data and the analysis tools available, Nowak and Greenfield published an important paper that provides solutions to the

methodological issues detailed in this analysis, as well as presenting some preliminary results from New Orleans.[43]

Protocols and Methods

Baseline Map

I. Open Photoshop:

a. Open the nine NOAA images and drag each image as a separate layer into a new (large) canvas.

i. Align each layer so the nine images create a coherent layout of the downtown New Orleans.

ii. Once aligned, select new mask for layer 1.

1. Select the paint brush tool, and adjust brush size to 35 and opacity to 25%.

2. Using the brush tool, lightly erase the edges of the layer. This creates a smooth blend between layers.

iii. Repeat for each layer as needed.

b. Once the nine images blend together, adjust the levels, curves and color saturation so the contrast and colors in each layer are similar.

c. Under layers, select flatten layers.

d. Crop image.

[43] Nowak, D. J. and E. J. Greenfield (2012). "Tree and impervious cover change in U.S. cities." Urban Forestry & Urban Greening 11(1): 21-30.

e. Resize the image to under 5mb. Save baseline image as a jpeg.

II. Open ArcMap:

a. Import newly created baseline image. Import the roads shapefile downloaded from the Census.

b. Under the georeferencing toolbar, select fit to display. Set the “layer:” as the baseline image.

i. Georeference the baseline image with the road shapefile. Three points were selected to make for a precise alignment of the two shapefiles.

The intersections:

Saint Louis Avenue & N. Broad Street
Saint Louis Avenue & N. Rampart Street
N. Rampart Street & Esplanade Avenue

ii. Save georeferenced points.

c. Import Tremé _calculatedarea shapefile.

III. Clip the baseline image to work off solely the area in the Tremé designated polygon.

a. Under data management tools, selected clip:

i. Input raster is the baseline photo.

ii. Output extent is the Tremé calculated area shapefile.

1. Selected “use input features for clipping geometry” to ensure the clipped area aligned with the Tremé boundary.

IV. Delete original baseline photo.

V. Create a new layer set

a. Import the USGS national elevation data (NED) for August, 2005.

b. Import the Tremé _calculatedareas shapefile.

c. Align the two separate layers within the map to depict their point of original from a referenced map.

Urban Canopy Analysis

I. Open ArcMap.

II. Imported Orthophoto (32471594.tiff) from USGS that includes Tremé .

III. Imported roads shapefile (census data).

IV. Projected roads shapefile in NAD_1983_UTM_Zone_15N to correspond with the Orthophoto projection.

V. Select the roads only within the Tremé designated area.

a. Tremé border (N. Broad St, Saint Louis Avenue, Esplanade Avenue, N. Rampart St).

b. Select all streets within the designated area.

c. Under the shapefile, go to Data, export new shapefile of only the roads in Tremé.

VI. In ArcCatalog:

a. Go to data folder, create a new polygon shapefile titled “Tremé _border.”

VII. Import new shapefile in ArcMap.

a. Under the edit menu, start an editing session.

b. Use *trace tool* to trace the outer border of Tremé along the streets (N. Broad St, Saint Louis Avenue, Esplanade Avenue, N. Rampart St). Note: There is significant tree canopy along Tremé’s perimeter, particularly along Esplanade Avenue with numerous trees along the neutral ground. To account for these and other trees along the perimeter, used the “modify feature” tool to ensure the outer sidewalks of the four streets served as the perimeter. Trees on the opposite side of the perimeter streets were not included.

c. Save edits, classified new polygon as the “Tremé _area.”

VIII. Calculated area tool:

a. Use “calculate area tool” to calculate the total area of only the newly edited Tremé polygon shapefile. Once the area is calculated, this number serves as the total area (square meters) to compare tree canopy and other impervious surfaces.

IX. Data Management tools, clip function:

a. Clip the original orthophoto to work off solely the area in the Tremé designated polygon.

b. Under data management tools, selected clip:

i. Input raster is original orthophoto.

ii. Output extent is the Tremé calculated area shapefile.

1. Select “use input features for clipping geometry” to ensure the clipped area aligned with the Tremé boundary.

X. On the original orthophoto, set transparency to 33% to distinguish area of interest (Tremé) and elsewhere.

XI. In ArcCatalog:

a. In my data folder, create a new polygon shapefile titled “canopy_miro” (the tree canopy +/- one street alongside miro street)

XII. In ArcMap, imported new canopy_miro shapefile.

Note: Divided canopy into nine corridors running northeast to southwest, parallel to N. Broad St. and N. Rampart St. Canopy shape file corresponds to the street +/- 1 street to the northeast/southwest.

XIII. Started editing session

a. Set 1 street +/- northwest and southeast of Miro St. between Saint Louis and Esplanade as the first corridor for the canopy analysis.

b. With polygon tool, began outlining trees.

i. *Criteria for canopy outline*:

1. Subjective analysis based on visual information to make canopy selection:

a. Do not include shadow.

b. Greenery relative to neighboring roofs (above or below as a distinction).

c. Make “best guess” as to what is a tree versus bush or shrub.

d. Shadow extent (length relative to height) used as a basis of distinction. The greater the shadow, the more likely the object in question was a tree.

ii. For unclear areas between what is/is not a tree, assumed a path to project a “reasonable canopy.” For obscure areas, the client’s consultation was required.

iii. Clusters of trees may have been included into one polygon. One polygon does not necessarily signify one tree.

iv. Trees whose canopy overlaps two corridors were accounted in the corridor where the majority of polygon was located.

c. Saved edits, close editor.

XIV. In the Data attribute table for each canopy corridor shapefile:

a. Under options, selected “Add Fields.”

i. Create “sq_meter” column: depicts total area for each polygon within the specified corridor in square meters.

b. Selected calculate geometry.

i. Under property, selected area.

ii. Under units, selected default (square meters).

c. Each polygon was granted a specific square meter calculation.

XV. Creating the corridors shapefile

a. In ArcCatalog, go to data file, new, polygon shapefile entitled *corridor_areas.shp.*

b. Import new shapefile into ArcMap.

i. Start editing session:

1. Using the select tool, select each corridor by along the Tremé border shapefile as well as the respective street boundary.

2. Using the trace tool, outlined the precise corridor area, making sure to account for the entire area within each corridor so all corridors account for the total area within the Tremé boundary.

3. Once completed the boundary, in the corridor_areas shapefile, open the Data attribute table.

4. Under options, clicked on “add field”

a. Created new text field named *Corridor*.

b. Created a second field named *sq_meter*.

c. Renamed corridor based on the central street.

d. Calculated area (square meters) for the corridor.

XVI. Saved edits. Repeated above process until all nine corridors were complete.

XVII. Calculated the total area of each corridor as well as each respective tree canopy cover in excel (by importing each tree canopy corridor .dbf file). 3.0.0520

Surface Area Analysis

Road Surface

I. Open ArcCatalog

a. Create a new polygon shapefile called “roads_handarea”

II. Imported *roads_handarea* into ArcMap.

a. Open editor, start editing session

b. Select target as roads_handarea

c. Task is set as create new feature

d. By hand, outline all road surfaces within the Tremé neighborhood boundary.

e. Click save edits, stop editing.

III. Under data management tools, select dissolve.

a. Input features: roads_handarea

b. Output feature class: select original data folder

c. Under dissolve fields: selected sq_meter

i. Statistic type : SUM

d. Once dissolve is complete, remove the original roads_handarea shapefile

IV. With new roads_handareadissolve shapefile, open data attribute table.

V. Under options, select add fields:

a. Add Fields

i. Create “sq_meter” column: depicts total area for each polygon within the specified corridor (square meters).

b. Select calculate geometry.

c. Under property, select area.

i. Ensure coordinate system for the data source is set to PCS: NAD 1983 UTM Zone 15N.

d. Under units, select square meters.

e. The entire road system within Tremé included a total square meter area calculation.

VI. Buildings

a. Set projection

b. In the Arctoolbox, under data management tools, projections and transformations, feature, select project:

i. Input dataset – buildings shapefile.

ii. Output dataset – original data folder.

iii. Output coordinate system: NAD_1983_UTM_Zone_15N.

c. Save new projected buildings shapefile.

VII. Buildings only in Tremé

a. In the ArcToolbox, under data management tools, select clip feature.

i. Input is original orthophoto.

ii. Output extent is the Tremé calculated area shapefile.

iii. Select “use input features for clipping geometry.”

b. New clipped shapefile replaced previous shapefile of buildings. Only buildings within Tremé remain.

VIII. Working with this impartial data, open the editor and select “start editing session.”

a. Select target as buildings_Tremé _project.

b. Task set to create new feature.

c. By hand, outlined all unidentified building surfaces within Tremé boundary.

d. Click save edits, stop editing.

IX. At many points throughout the map, tree canopy covers both roads and buildings. To ensure no layer overlaps the other, use the erase tool to calculate the net street surface, net building surface and total tree canopy area (in square meters).

a. Merge all tree canopy shapefiles

i. In ArcToolbox, select Merge under Data Management tools. Select the nine tree canopy shapefiles, merge them into one shapefile called canopy_Tremé.

b. Ensure no area duplication in calculation

i. In ArcToolbox, under Analysis tools/ Overlay/ select Erase.

1. For input features, selected roads_handarea_dissolve.

2. For erase features, selected canopy_Tremé .

ii. Repeat same step for buildings, using both the new roads shapefile and the canopy_Tremé file to ensure no overlap in the calculation.

X. Calculating total areas:

a. Export canopy_Tremé , buildings_Tremé _project and roads_handarea .dbf files into excel. Also export the Tremé _area .dbf total area shapefile.

b. Using the total area calculations for each shapefile, take the difference of the tree canopy, street and buildings total areas from the total area in Tremé to derive the total area for all *other* areas – the fourth surface designation – in the analysis.

c. Import Excel spreadsheet into ArcMap .mxd file.

XI. Repeat analysis for 2009 data. Complete: surface area analysis: March 2006 and February 2009.

APPENDIX 4

COMMUNITY GARDENS IN THE 9TH WARD POST-KATRINA RAPID ASSESSMENT – APRIL 22-26, 2006

As a part of the Cornell City and Regional Planning Department New Orleans Planning Initiative (NOPI) I conducted field site visits at the following community gardens in the 9th ward in the spring of 2006, roughly 6 months after Hurricane Katrina. These sites, though not figuring into the dissertation chapters in a major way, led me to the hypothetical model of trees and tree planting as the important resilience conferring human-nature interaction in New Orleans after Hurricane Katrina, and as such, are important to document in this dissertation.

BYWATER HERB GARDEN - Poland and Rampart Streets

Garden located on site of former Police Horse Barn. This garden is actually a market garden, farmed mostly by one man named Paul Osino. Paul is an herb farmer, and sells his crops at local markets such as the French Market. He also makes pesto and other specialty items using his herbs. Paul indicated that he now receives nearly all of his income from organic farming in his community garden space. We sampled his various herbs. Paul is very open to others using the garden and sharing plots, but no-one has emerged that is interested yet. The Bywater Herb Garden was recently soil

tested to be sure nothing toxic was deposited by the hurricane and the soils tested fine; no problems selling at public markets.

Figure A4.1. Bywater Herb garden.

MISSION UTOPIA - North Rampart and Press Streets

Shares space with Habitat for Humanity. A conflict emerged between Habitat and Parkway Partners post-Katrina involving faulty communication on this lot resulting in destruction of planting beds, and frustration among the stakeholders. Prospects are good for resolution of this conflict if Habitat admits error and initiates a good will gesture to assist community gardeners. This garden was used by a local AIDS rest house and as a teaching center for students from the Desire Street Academy.

Figure A4.2. Mission Utopia garden.

MUSIC ON RAMPART - corner of Rampart and Music streets

A smaller garden next to a rental house. Some issues with landowner and renters, mostly minor children related mischief. One gardener has returned. This garden has many gardeners including one from Tulane who grew beautiful crops. Some storm damage and in need of fence repairs. Volunteers recently cleared the site entirely and reset plots.

LE MARGINY - Burgundy and St. Ferdinand

This garden has some crops and many show plants. The plots were all used by several gardeners. One tree died in the storm and was removed, but the stump remains to be ground up. The plantings in parts of the garden are habitat plantings. Two active Purple Martin “condos” on the site. The garden is adjacent to an abandoned church on Burgundy and Mario is hoping to help local gardeners use this property to make room for more gardens.

LAURENTINE ERNST - Forstall and Chartres (Holy Cross)

This is a smaller garden in a state of neglect. Home owners are unaccounted for or have not/ will not return(ed) yet. This garden featured a lot of container gardening.

GENESIS GARDEN (Forstall I) Fortsall, Lower 9th ward

This was a show garden, one of Parkway Partners signature community gardens. Had very ornate roses and other plantings as well as food production. Completely destroyed. Littered with wreckage. All that remains is a pile of rusty tools. No one has heard from any of the former gardeners, and this garden was in the area hardest hit by the breaching/overtopping of the levee. Mario gave me a 60's era "entrenching tool" that was a favorite mini shovel used by the gardeners. It is a rusty relic now, but an important artifact and memento for me.

FORSTALL II - Forstall, Lower 9th Ward

All that was left of this garden was the battered Parkway Partners sign on the flattened fence. A house has blown/floated, washed onto a part of the garden. Water was spewing from a pipe. Daffodils were trying to grow, as were other bulbs, amongst the wreckage and debris. The lead gardener lived next door. The home no longer exists. Mario has not heard from the gardeners or the home owners.

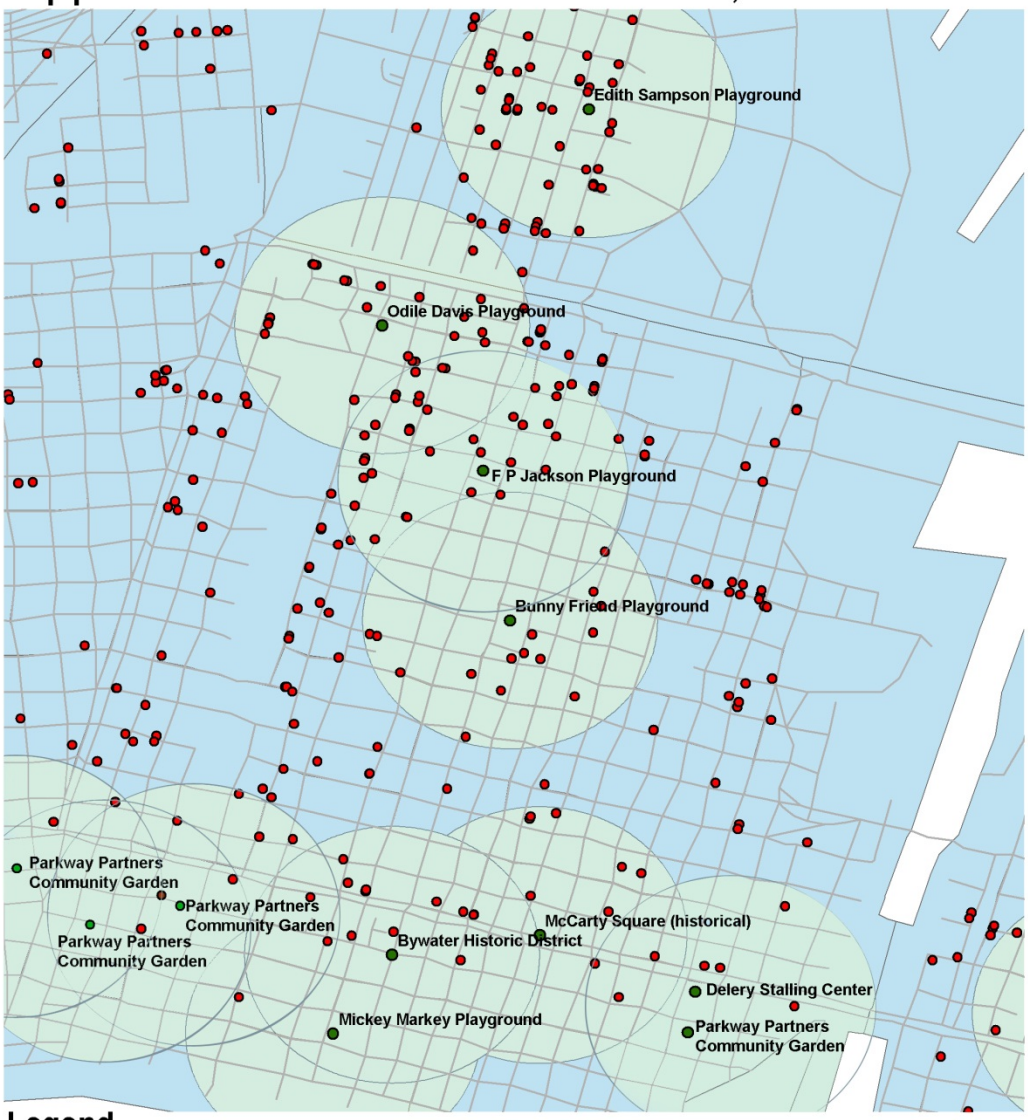
Figure A4.3. Forstall II garden in ruins.

In general, it appears there have been community garden activities in the 9th Ward that have been viewed favorably my community members and the community at large, and that have contributed in important ways to community efficacy in the past. The question now is, what role might community gardening play in efforts to rebuild the 9th Ward?

Figure A4.4. The Gathering Tree garden.

Figure A4.5. Sun Done/Meg Perry garden.

Upper 9th Ward Park Service Area, Pre-Katrina



Legend

- Park Service Area
- Parks
- Adjudicated property
- Blighted property

0 0.1 0.2 0.3 0.4 Miles

Source:
Regional Planning Commission for Jefferson, Orleans, Plaquemines, St. Bernard and St. Tammany Parishes.

Figure A4.6

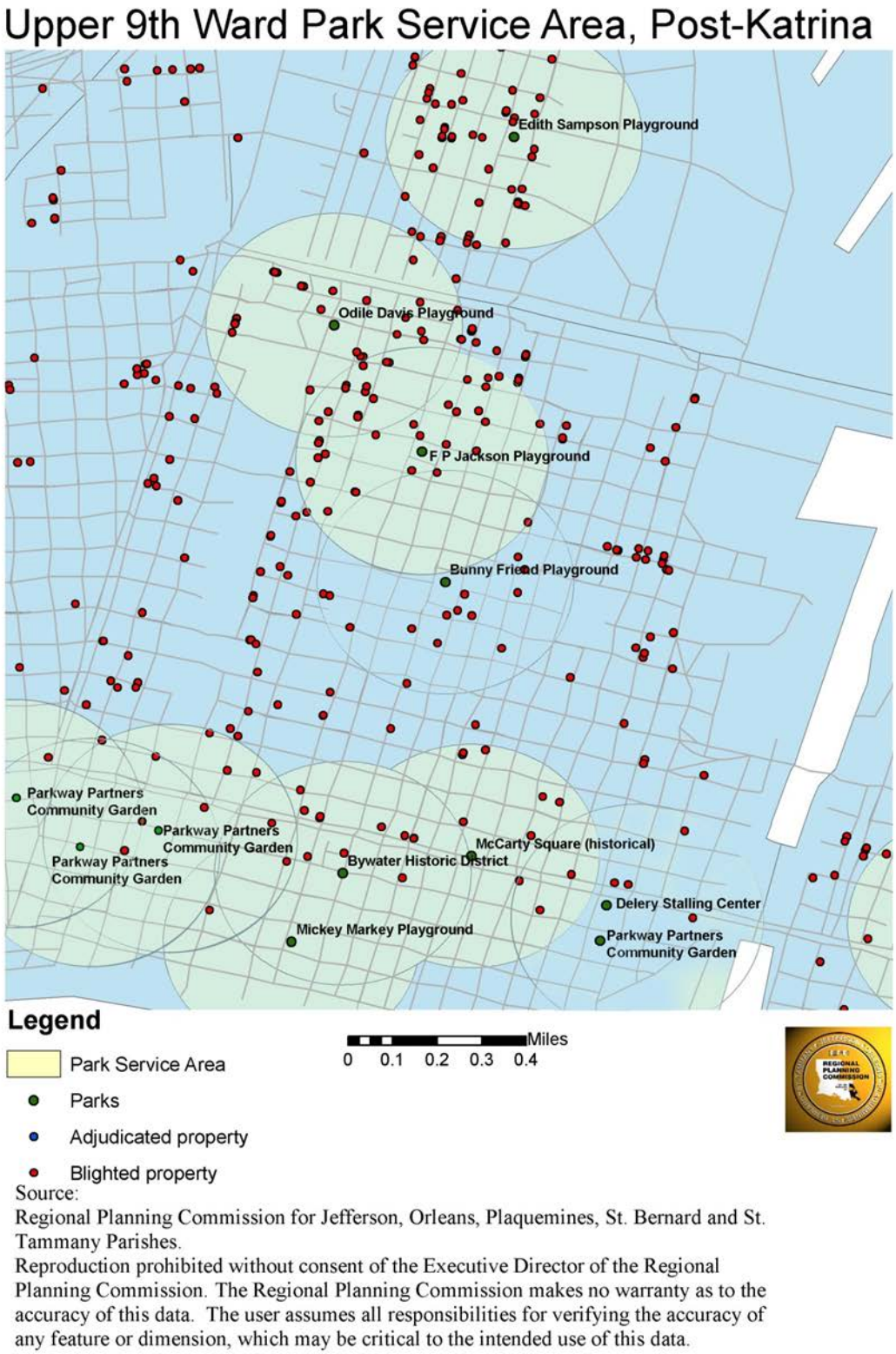

Upper 9th Ward Park Service Area, Post-Katrina
Edith Sampson Playground
Odile Davis Playground
F P Jackson Playground
Bunny Friend Playground
Parkway Partners Community Garden
Parkway Partners Community Garden
Parkway Partners Community Garden
McCarty Square (historical)
Bywater Historic District
Delery Stalling Center
Mickey Markey Playground
Parkway Partners Community Garden
Legend
Park Service Area
Parks
Adjudicated property
Blighted property
Miles
0 0.1 0.2 0.3 0.4
REGIONAL PLANNING COMMISSION
Source:
Regional Planning Commission for Jefferson, Orleans, Plaquemines, St. Bernard and St. Tammany Parishes.
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Figure A4.7